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TECHNOLOGY DEPARTM'T SEP 19 1952

ON THE COVER

THE finishing operations on Goodyear Vinylfilm, a thin plastic that goes into rainwear, shower-bath curtains, garment bags and the like, are performed on the calender rolls shown on our cover. The machine is claimed to be the fastest of its kind. Each of its rolls is 92 inches long, 32 inches in diameter and weighs 25,000 pounds. Through holes that are drilled longitudinally through each roll just beneath the surface, high-pressure water is circulated to maintain a roll-face temperature of 355°F.

Following the calendering, the plastic may be embossed, in which case the embossing roll is pressed against it by two 12-inch air cylinders (shown on either side at the level of the man's feet) that exert a pressure of 150 psi.

The finished material is wound on a roll that is equipped with a yardage counter. When the length for which the machine was preset has been wound, two other cylinders, not shown, operate a heated, serrated knife that cuts the material. A new roll is then started on an empty core, which replaces the filled one.

The calender was built by Adamson-United Company, Akron, Ohio.

●

NEXT MONTH

WHAT major city
—is underlain by quarries that were worked from 50 B.C. to 1800 A.D.?
—has a compressed air distribution system from which any household, store or industry can obtain air as easily as it does gas or electricity?
—operated successfully for 50 years several dozen public pneumatic clocks?
—has in its heart a depository containing the remains of six million of its citizens?
—has two complete and separate water-distribution systems serving its entire area?

The foregoing are a few of the things about Paris that are little known. They will be covered in detail in a 2-part article, *Paris Underground*, scheduled to start in our October issue.

●

CORRECTION

IN THE article, *Gliding and Soaring*, July issue, it was stated on page 197 that "Langley . . . with his steam-engine equipped *Aerodrome* . . . flew a distance of half a mile in 1896." It is pointed out by Arthur H. Morse, of the Baldwin Company, Cincinnati, Ohio, that this is incorrect. Langley built two steam-driven *models* that flew successfully but without a passenger. His *Aerodrome*, which was intended to carry a man, was powered by a radial gasoline engine (designed by Charles Manly). A pilot failed in two attempts to launch it.

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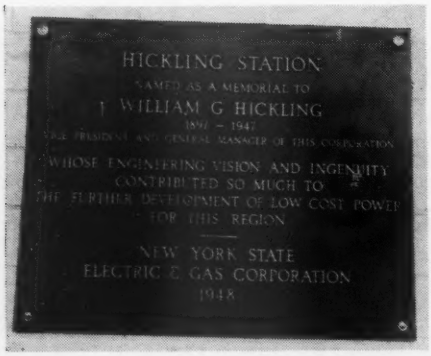
More Power from Hickling Station

Century-old New York State Utility Adds 50,000-kilowatt Generator to Its Expansive Electrical Network

J. C. Pierce



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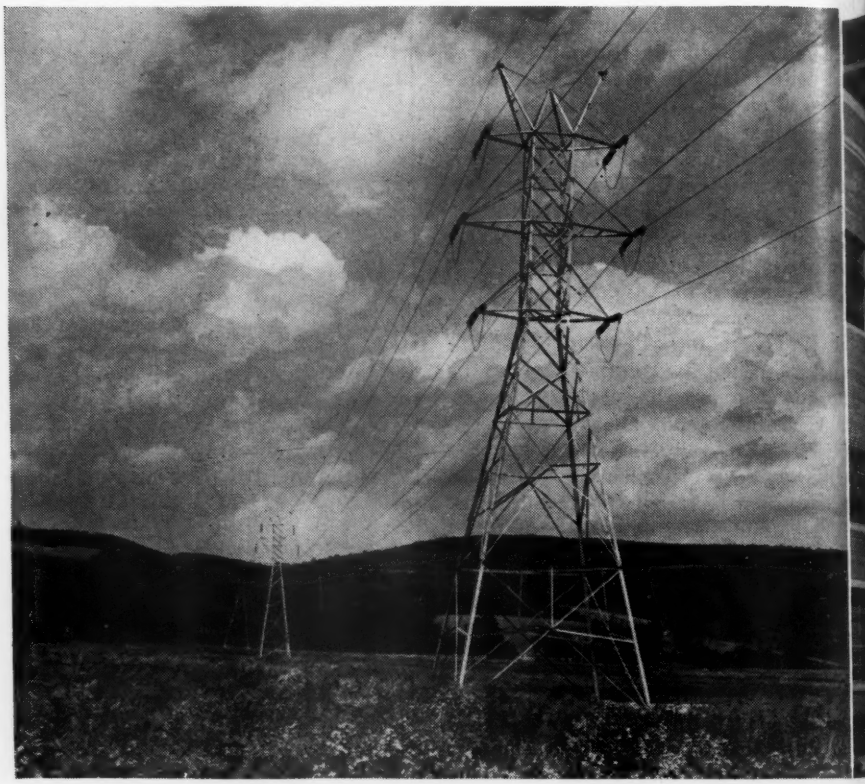


SPEEDING KILOWATTS TO MARKET

Hundreds of miles of transmission lines are required to deliver power throughout the 16,700 square miles in 43 New York counties that the system serves. The territory contains 1,400,000 people and is predominately rural.

THE public utility electric companies have unusual marketing problems. Their product cannot be stored against future orders, yet must be available when wanted. Moreover, there must always be enough surplus producing capacity to satisfy any sudden abnormal demand and to take care of new customers without delay. Because people rely heavily on electricity in their homes, stores and industries, the power companies shoulder a large responsibility. To meet it they call upon the best engineering talent and equipment to be had and strive ever to build not only for the present but also for a reasonable period in the future. Thomas A. Edison would be pleased if he could see what has grown out of the first central station he established in 1882 on Pearl Street in New York City to light the electric arc and carbon-filament incandescent lamps of the neighborhood. He would marvel at modern central stations such as Hickling Station.

Hickling is one of five steam generating plants owned and operated by the New York State Electric and Gas Corporation, which also maintains six hydroelectric plants. It is situated just outside of East Corning, N.Y., on a spot on the Chemung River where General Timothy Pickering negotiated an important treaty with Iroquois Indian chiefs in 1791. The station's first generator, a 30,000-kw unit, began in October of 1948 delivering 13,800-volt current to an adjacent substation where it was stepped up to 33,000 and 114,000 volts and fed into transmission lines. Shortly afterward the generator was speeded up to its capacity rating of 35,000 kw and the station maintained that output until upon the completion of a recent expansion program, it was provided with a new 50,000-kw unit to meet the growing needs of the territory served. This additional generator went on the line on June 6 of this year, three months ahead of schedule. Gilbert Associates, Inc., of Reading, Pa., designed the plant. The original construction was handled by Sordoni Construction Company, of Forty Fort, Pa., and the new section was erected by C. D. Murray Company, of Syracuse, N.Y.

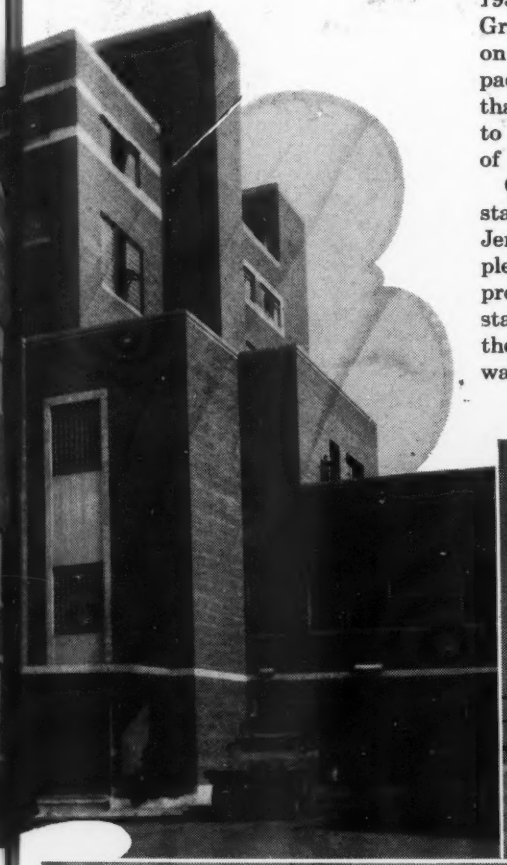
The New York State Electric and Gas Corporation is one of the nation's older utility concerns, having been in business an even hundred years. Consequently, all the miracles of modern electrical engineering have taken place within the span of its corporate existence. As the Ithaca Gas Light Company, with a capitalization of $75,000, it began, in 1852, making illuminating gas from coal in iron retorts. Inspired by the success of Edison's incandescent lamp, the company turned to the new lighting source and provided its first electric service in the early 1880's. It furnished current for one of the first rural applications of electricity on the farm of L.C. Pyser who, in 1891, installed lighting in his poultry houses to promote egg production—a practice usually considered to be a strictly modern innovation.

Numerous consolidations and expansions through the years have brought the company its present name and a service territory of some 16,700 square miles spread over 43 counties of New York State—about 35 percent of the state's land area. Its capital investment in property, plant and equipment and including its gas facilities now stands at $201,865,000. It serves some 1,400,000 people, about 70 percent of whom live outside city limits. This population is stable, deriving its livelihood principally from diversified industries and some 48,500 farms.

The addition to Hickling Station is but one of several system construction projects recently completed or now underway. All are included in a program under which $76,000,000 will be expended during the years 1952 to 1955, with the greatest portion going to increase the

UNUSUAL STATION VIEW

s seen from this angle (below), the ation might pass for a manufacturing lant and that conception is not far rong, as it is essentially a factory that rns out an invisible but highly neces- ry product.

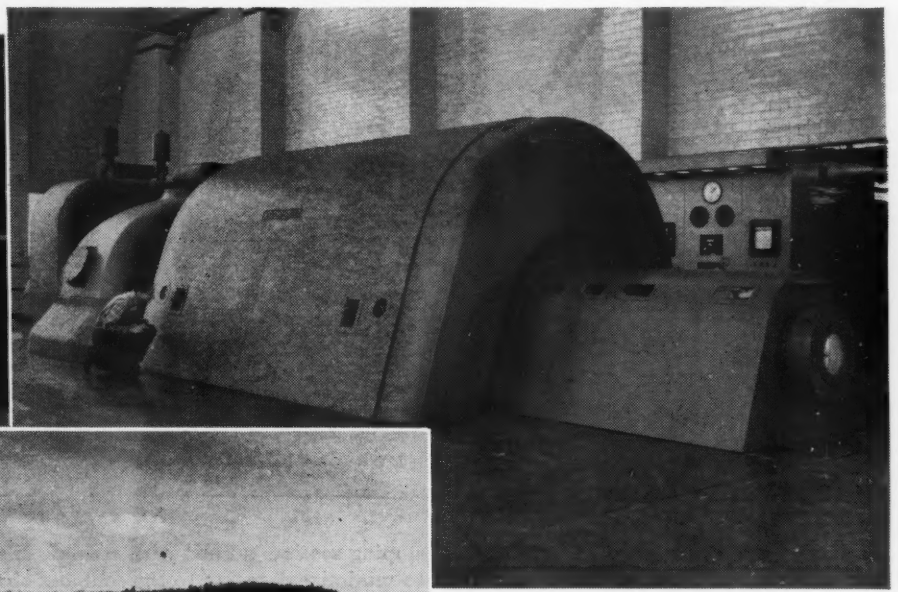


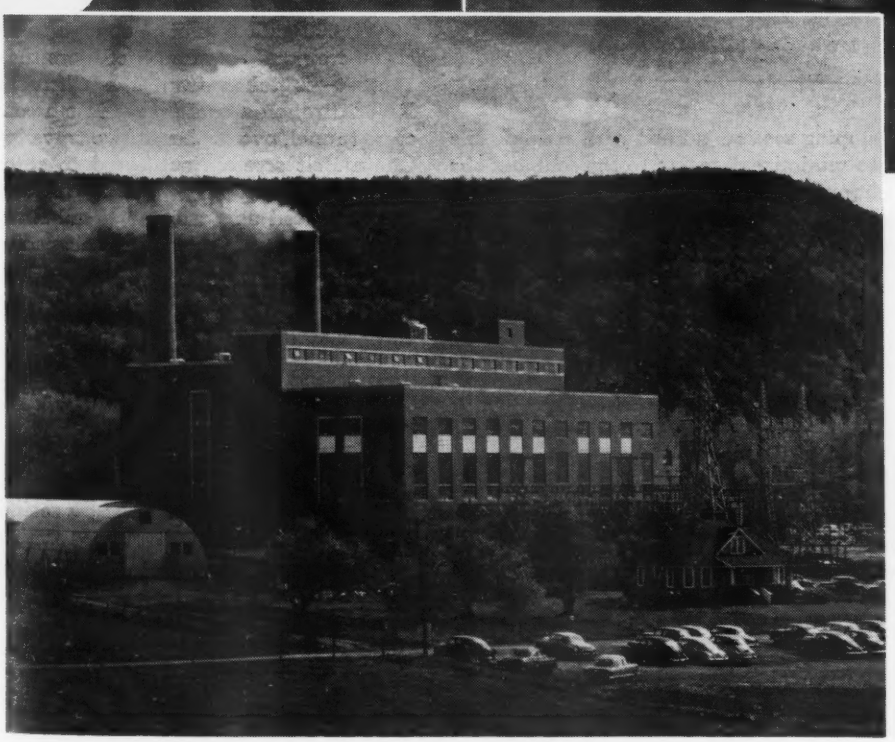
steam-generating facilities. On December 26, 1951, a 75,000-kw addition to the Goudey Station near Binghamton brought that plant's capacity up to 174,000 kw. Started in November, 1951, and scheduled for completion in late 1953 is a 100,000-kw addition to the Greenidge 92,000-kw station at Dresden, on Seneca Lake. Total generating capacity in this "central area" is now more than 400,000 kw, and it will be increased to above 500,000 kw at the completion of the program.

Of the four other steam generating stations in the company's network, the Jennison Station at Bainbridge, completed two years before Hickling, is the prototype for the original Hickling installation. The main difference between the two as they were initially operated was the higher steam operating pressure of 850 psig and temperature of 900°F at Hickling as compared with Jennison's 650 psig and 825°F. The increases put into effect at Hickling were designed to offset the rising cost of fuel and they made Hickling the lowest-cost steam generating plant in the system.

Like all central stations, Hickling is a factory into which pour great quantities of raw materials by train, truck and conduit; where millions of dollars worth of equipment hum under the supervision of trained technicians, and from which emerges a single invisible salable product that goes to market over a network of solid wires. Those characteristics lend emphasis to the fascination of the production of electricity and to the mysteries of electricity itself.

The principal raw materials are, of course, fuel and water. As Hickling is located near the anthracite coal region of Pennsylvania it was logical to choose that fuel. When operating at its full 85,000-kw capacity, the plant requires about fourteen carloads, 800 tons, daily of No. 4 buckwheat size, and the handling of this material from dumping hopper to ash disposal is a model of mechanical efficiency.





HICKLING STATION

One of five steam-powered generating plants operated by New York State Electric & Gas Corporation in the central area of its system. Originally of 35,000-kw capacity, it has recently received a new 50,000-kw generator and the requisite accessory equipment. The initial turbine generator, which runs at 3600 rpm, is pictured at the upper right.

Unruly weather cannot be allowed to jeopardize the smooth operation of such plants and consequently a great deal of attention is paid during design and construction to providing adequate protection against the elements. So that the flow of fuel to Hickling's boilers can be handled under any weather conditions a track hopper house that accommodates four railroad cars at a time was built. The dumping hopper will hold the contents of an entire car. From ample yard trackage off the Erie Railroad spur that serves the plant, cars are shuttled in for dumping by a plant-owned 18-ton Plymouth locomotive powered by a six-cylinder Buda gasoline engine. Facilities

COAL PILE AND STOKERS

The fuel is No. 4 buckwheat size anthracite coal—of about the same consistency as coarse-ground coffee. About 800 tons is burned daily, arriving in railroad cars that are dumped directly into the plant handling system. A huge reserve pile adjacent to the station receives its supply by diversion of any surplus from inside the station. The coal is distributed over the stockpile area by an Allis-Chalmers bulldozer (right). The fuel is efficiently burned in four traveling-grate stokers. The charging ends of two of them are pictured below. Stainless-steel-lined chutes feed the fuel from overhead bunkers. The sectionalized baffle plates between the chute bottoms and the grates conceal the fury of the flames as they are fanned by 290-degree air from a high-capacity fan.

for thawing frozen coal in the cars and a car shakeout mechanism are provided.

From the hopper, coal is handled by 100-ton-per-hour Link-Belt conveying equipment beginning with four reciprocating feeders that draw it from the hopper onto an inclined belt conveyor equipped with a Merrick Scale Manufacturing Company Weightometer. A chute from the coal storage facilities in the yard, where some 70,000 tons are normally kept in reserve, also discharges onto this belt so that the fuel can be weighed into the plant during reclaiming operations. This weighing conveyor discharges into a bucket elevator at the head of which coal can be diverted to the storage yard, or continue onto a second inclined belt that discharges into an 18-inch Link-Belt screw conveyor, which distributes it to four 350-ton bunkers. All conveyor belts are 24-inches wide, and are operated at 200 feet per minute by General Electric motors.

The reinforced concrete bunkers have vertical sides with the exception of the rear one, which slopes 50 degrees toward the discharge chutes from a point about two-thirds down from the top. This sloping section is lined with ceramic tile to minimize abrasion to the coal and the hopper and to present a free-flowing discharge surface. The fuel flows by gravity from the bunkers to the stoker hoppers through stainless steel lined chutes that are being replaced when necessary by Gates Rubber Company steel chutes lined with a ⅜-inch thickness of rubber.

The traveling grate stokers are said to be the largest in the utilities field. Each of the two original units is 24 by 28 feet and weighs 125 tons, while the new units are 26½ by 28 feet, with an effective grate area of 742 square feet. All are of the Lloyd type made by Combustion Engineering-Superheater Inc. The normal coal bed on the grates is 3½ to 4 inches deep. The grates, made up of thousands of thin cast iron keys dovetailed to cast iron grate bars, are equipped with variable speed drives that can vary the rate of travel from 0 to 90 feet per hour. Nine separate compartment dampers under the fuel bed can be manually controlled to vary the draft condition. Ashes drop continuously from the discharge end of the stoker into a flooded pit. A grid on the refractory-lined pit outlet breaks up clinkers and the ash-water mixture is removed by a United Conveyor Corporation hydraulic jet to a settling basin, where a local cinder-block manufacturer takes over the product. The ash handled is about 12 percent of the coal by weight and approximately 96 tons are discarded daily.

The huge volume of water required for steam generation, steam condensing, machine cooling and other usages is a major consideration. The cooling water, about 75,000,000 gallons daily—enough to fill a 20-acre pond to a depth of more than 11 feet—is taken from the Chemung River through a trash rack, into a concrete tunnel, over either of two traveling Chain Belt screens, subjected to automatic intermittent chlorination and thence picked up by six Ingersoll-Rand circulating pumps varying in capacity from 4,380 to 10,200 gpm. These pumps deliver it to the circulating-water header from which it goes to the condensing, hydrogen-cooling, screen-washing, ash-sluicing and house-service systems.

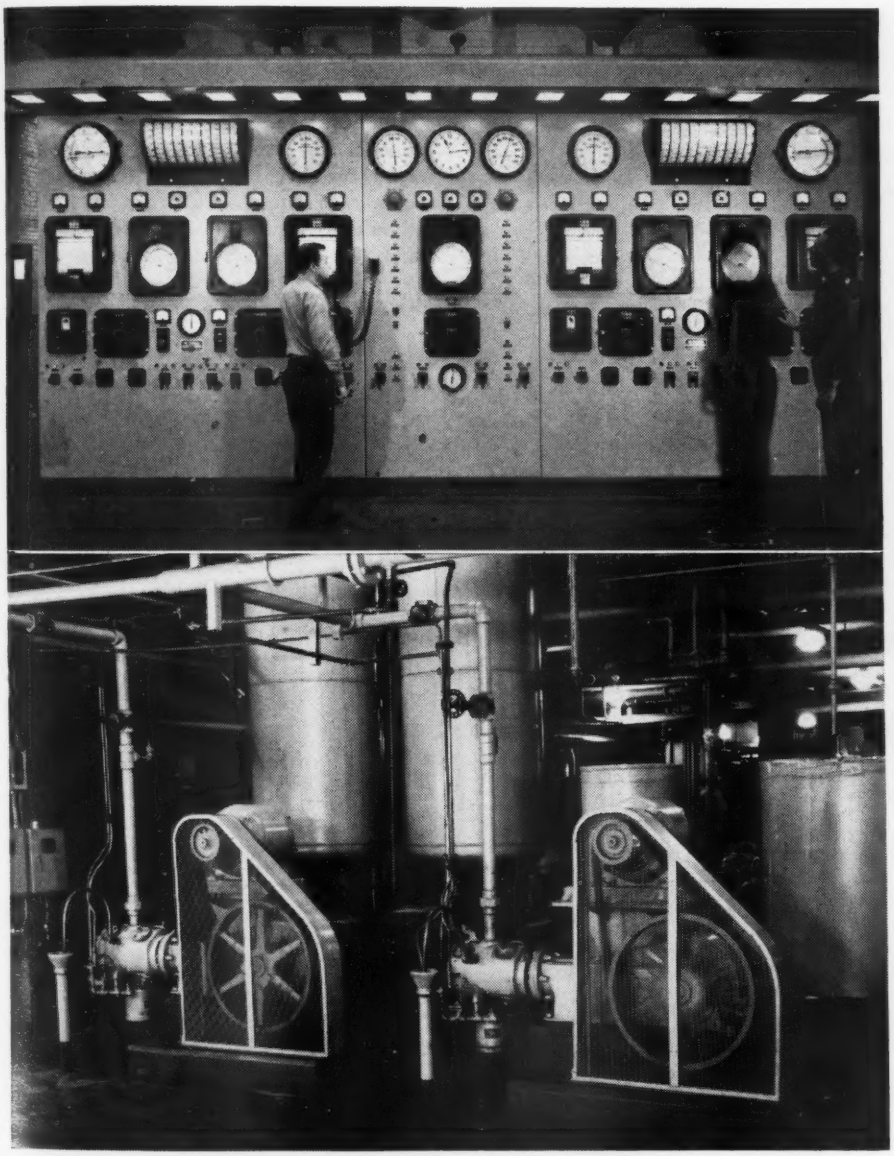
Two deep wells within the building foundations furnish make up water to the steam system in a volume equivalent to about 1 percent or the total steam generated. After it is treated by zeolite softeners to remove all scale-forming salts, it is pumped to an American Locomotive Company evaporator, which is equipped with a heater and deaerator. From the evaporator the distillate is admitted to the feed-water circuit of the steam system as a vapor. A 12,000-gallon and a 20,000-gallon tank full of treated feed water are kept in readiness to be pumped into the boiler-feed system in the event of an emergency—such as boiler tube failure.

The role of the chemical laboratory in power generating plants usually goes

practically unnoticed, yet it is of vital importance to the operations and deserves recognition. It is the laboratory's function to know when the water isn't exactly right for a given application. It is the laboratory's responsibility to detect in their early stages such things as an undue build-up of organic growth in a condenser, the plugging up of an evaporator by salt-forming scale or unsanitary and unhealthy drinking water.

Analyzed daily are samples of river water, well water, softened water, evaporator water, evaporator salines, evaporator distillate, boiler-feed water, boiler salines, boiler saturated steam, condensate, condensate returns, feed-water storage and circulating water. The analyses include determination of one or more of the following: pH (hydrogen ion concentration ratio which tells the relative acidity and alkalinity), hardness, turbidity, chlorides, sulphite, phosphate, sulphate, iron, silica, oxygen, carbon dioxide, ammonia, conductivity, and chlorine residual.

The laboratory personnel regulate and supervise all water treatment operations. In addition, they take, prepare and analyze for moisture percent a daily sample of all coal burned. From these samples a weekly composite is prepared for the main laboratory of Gilbert Associates, consultants, where it is further analyzed. They take daily samples of the ash from each boiler for a similar composite for the central laboratory. They inspect all equipment taken from service, checking it for corrosion, erosion and deposition. Samples are taken from any deposits found and sent to the central laboratory. These technicians also conduct any special investigations that may be requested such as water system iron pick-up, rate of deposition of foreign material in heat exchangers, efficiency of gas removal equipment, etc.



INSTRUMENTATION

One of the instrument boards (top) that tell at a glance how various components of the station are functioning. Many of the instruments are operated by air and it is important that the fluid contain no slugs of moisture or oil that might clog the small delivery lines or minute openings in the instruments. For this reason, the air is compressed by machines (above) that have carbon piston rings, which require no lubrication. They are Ingersoll-Rand NL (non-lubricated) units of the ER belt-driven class. Another I-R compressor, of 304-cfm capacity, supplies air at 100 psi for general purposes such as operating pneumatic tools used in maintenance work.

Now let us combine the fuel and water to make each hour the 750,000 pounds of steam required to produce the 85,000-kw of electric energy. The stokers already described are under the two original 175,000 pounds-per-hour steam generators (boilers) made by Combustion Engineering-Superheater, Inc. and two new 220,000 pounds-per-hour units, of Babcock & Wilcox manufacture. The boilers are massive 2-drum units, some six stories in height, that are constructed to operate safely at a pressure well above the 900-psi operating rating. They and their accessory equipment are designed to produce the maximum of steam energy per unit of energy input—the ultimate in sound combustion engineering.

As the burning coal bed on the stoker grates is fanned by air preheated to about 290°F and forced up through it by fans with adjustable pitch vanes, the hot gases carry some unburned and partially burned coal particles upward. This material is trapped in Western Precipitation Corporation "precipitators" at a point ahead of equipment to which its abrasive action would be damaging. The precipitators gather this unconsumed fuel for its return, together with the stoker siftings, to the coal bed for complete combustion. Above the precipitators in the blast of hot flue gases are the air preheaters mentioned before and the economizer. This latter unit is a group of tubes in which the water that will be converted to steam is preheated to about 425°F prior to its delivery to the main steam generating banks and thence to the boiler superheaters where it becomes steam at 910°F and 900 psi pressure. Now the gases that have been cleaned of entrained energy particles and that have imparted their heat energy to the boiler tubes and auxiliary equipment are drawn by induced-draft fans through the boilers and heat traps from which point they are delivered to the 150-foot-high stacks and discharged into the atmosphere at about 300°F.

Steam enters the turbines from nozzles at a speed of about 2000 miles per hour to spin the turbine shafts that drive the generators and make the electricity. Hickling Station's original turbine-generator consists of a Westinghouse 29-stage-turbine direct-connected to a 30-000-kw hydrogen-cooled generator. The newer turbine generator is a General Electric 50,000-kw unit operating under the same conditions as the other one.

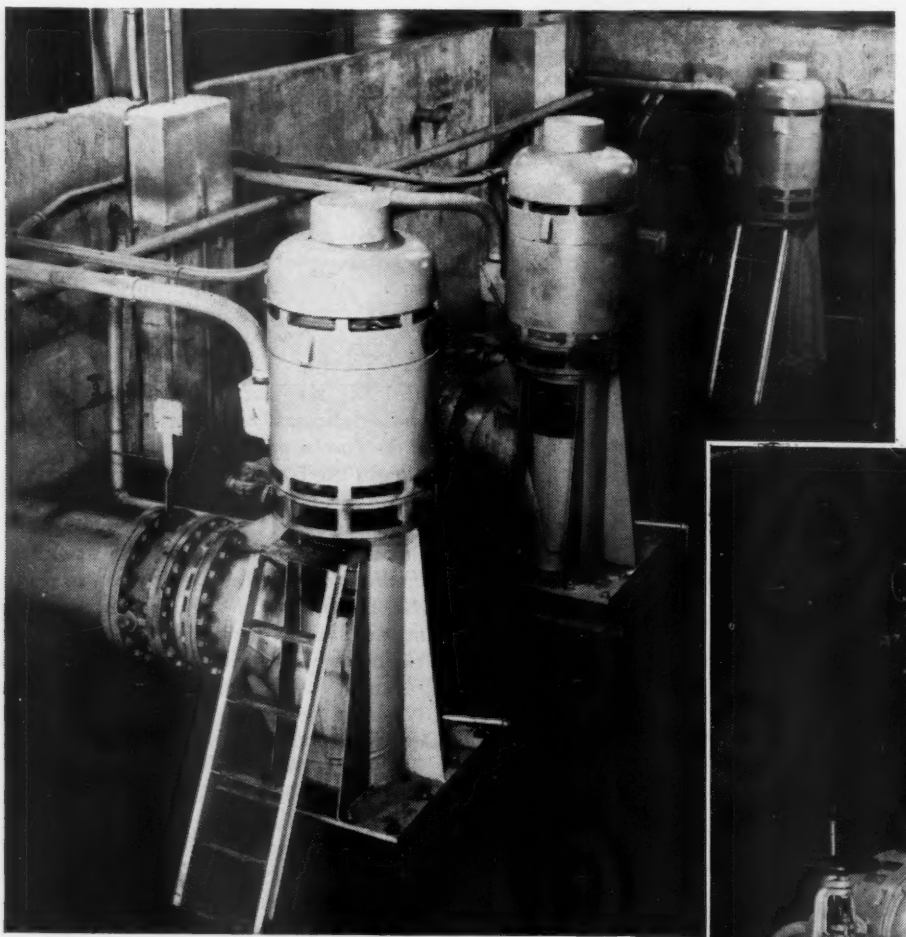
Hydrogen instead of air is used as the medium in which to operate the 3600 rpm generators for the following reasons: It is lighter than air and thereby offers less resistence to the rotating element —incidentally, this quality decreases the noise made by the generators; it has higher thermal conductivity and heat transfer coefficients and thereby cools the generator faster; it tends to reduce maintenance expense because of the absence of dirt and moisture in the sealed hydrogen circuit; and it increases the life of insulation on the generator stator winding because of the absence of moisture and oxygen. It is non-combustible when free of air and the small amount of leakage is compensated for by additions from steel cylinders kept in storage. The pressure is automatically limited to 15 psi and the gas is cooled by circulating cold water through coils built into the generator frame. To increase the advantages of hydrogen cooling, Hickling is currently preparing to carry 30 psi pressure in the hydrogen systems.

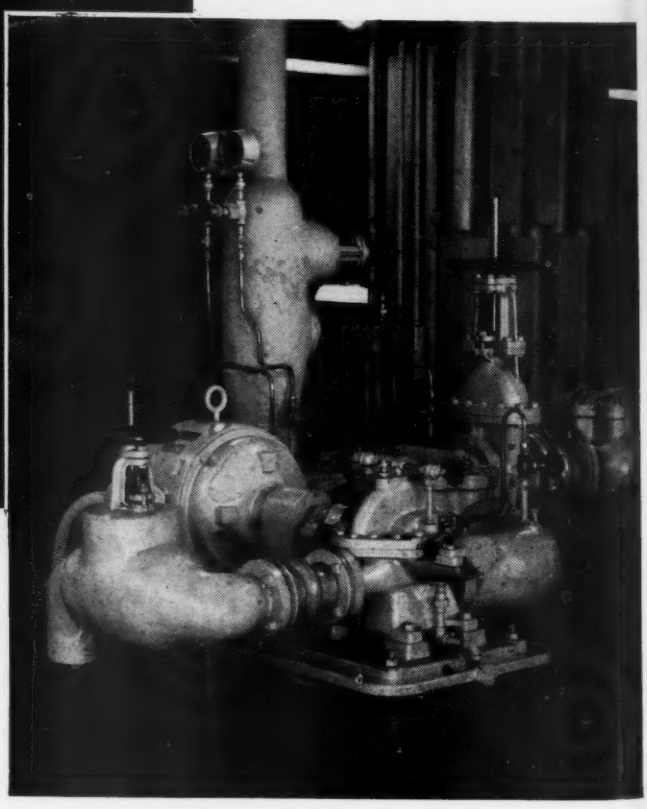
One of the more critical parts of a steam generating plant is its condensing system. Efficient condensing conserves energy and furthers economical plant operation. The steam blast that is nozzled into the turbine rapidly spends most of its energy against the hundreds of turbine blades, but it is not discarded at this point as in early-day practice. Although its heat, pressure and velocity energy are greatly dissipated, it is a purified, valuable product that is saved for reuse. But before it again can be reconverted to the 900°F, 900-psi force needed to spin the turbine and generator shafts it must be restored to the liquid form. This is the job of surface condensers.

The condensers at Hickling are twin-heart type Ingersoll-Rand Company units set immediately under the turbines. Each unit is in reality two condensers side by side and acting in unison. This design is sometimes chosen where conservation of headroom and, consequently, conservation of building materials are factors. Other distinct advantages of this type condenser are that one side can be shut down at a time for inspection, maintenance or repair, and the two halves can be shipped completely assembled thereby eliminating much field assembling.

The first condenser installed at Hickling contains 26½ miles of ¾-inch tubes having a surface area of 27,500 square feet exposed to steam contact. Through these tubes the cool river water is circulated and around them flows the spent steam to be condensed into 90°F water. The second condenser is considerably larger, having 42,500 square feet of tube surface. The condensate drops from the tubes into hot wells below the tube sections and from there it passes to Ingersoll-Rand 500-gpm condensate pumps that force it through feedwater heaters where live steam brings its temperature up to about 180°F. It is then piped to a deaerating heater where it is heated further by steam and this drives off dissolved oxygen, ammonia and carbon dioxide gases. At this point the required make up water is added and it is pumped at 1000 pounds pressure by 600-gpm boiler-feed pumps through a high-pressure heater where more turbine steam raises the temperature to about 350°F. From there it goes to the economizer and is then back in the circuit previously described.

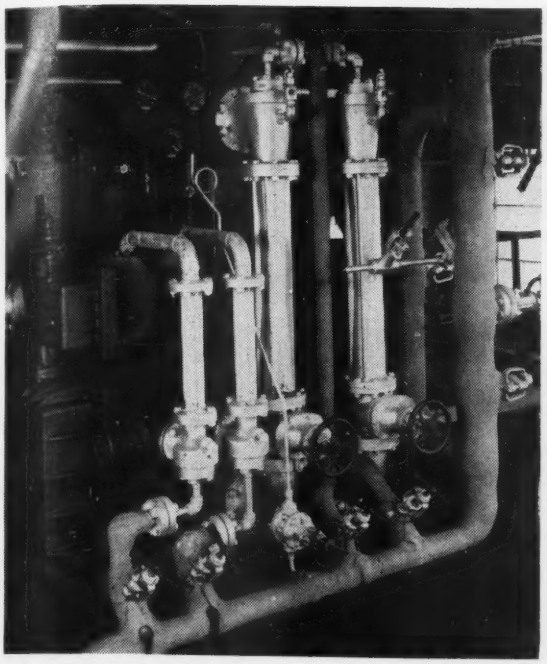
In any plant there will be some failures of mechanical equipment. To enjoy maximum insurance of an uninterrupted flow of 13,800-volt current from Hick-

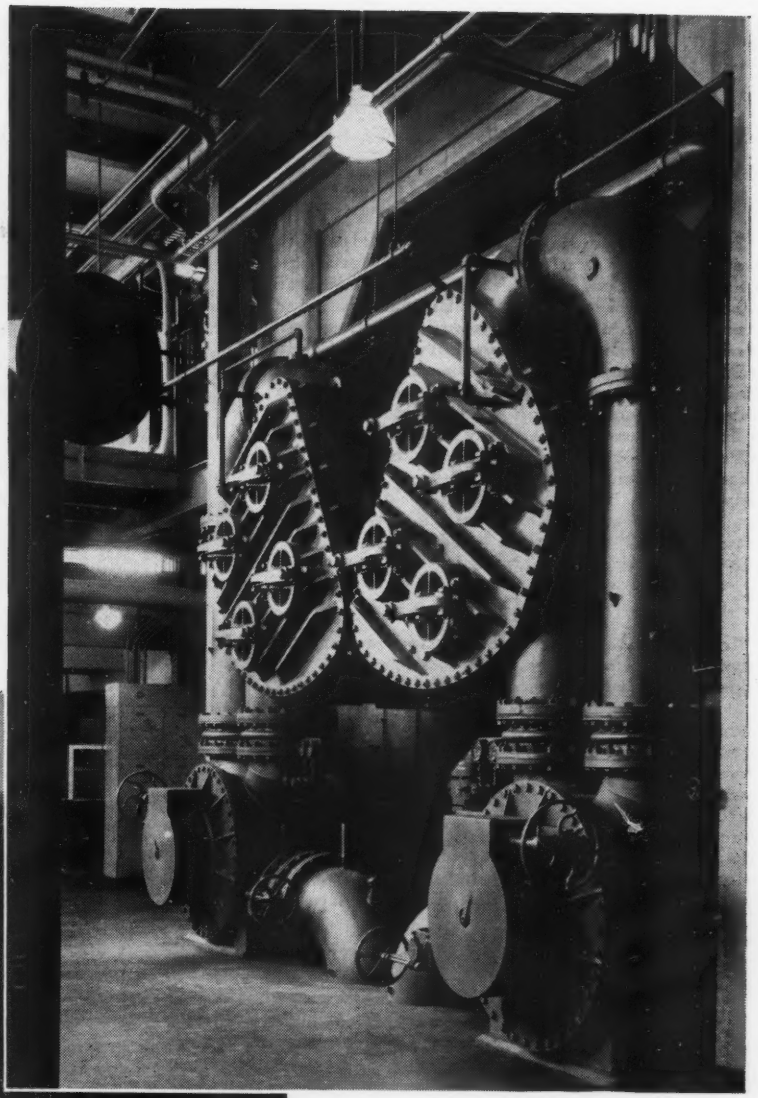


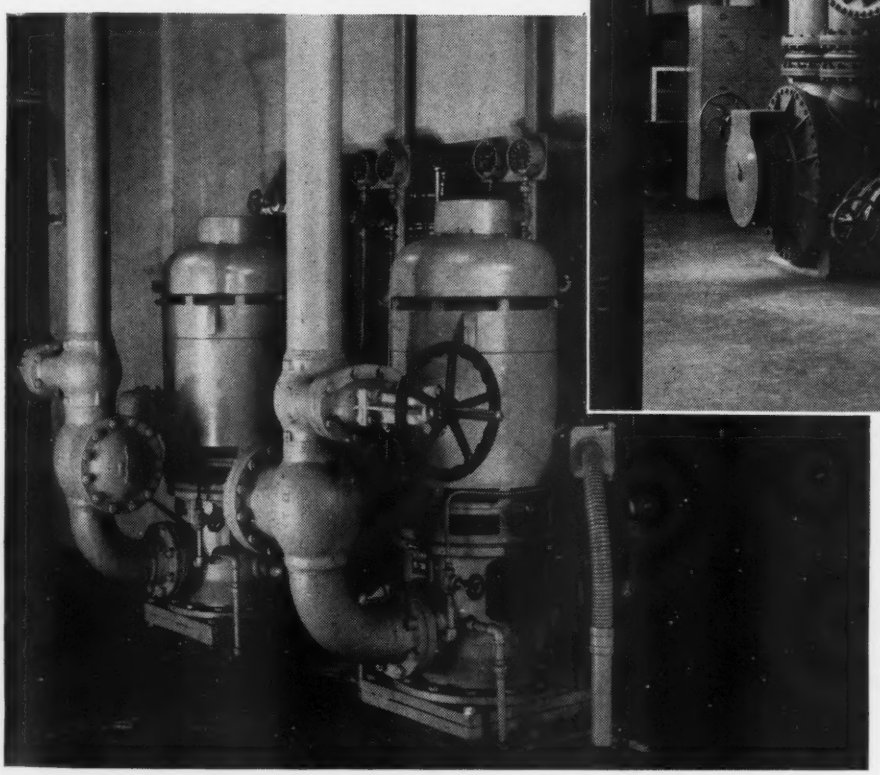


WATER PUMPS

Above are shown three of six Ingersoll-Rand vertical pumps that each day send about 75 million gallons of Chemung River water into the station for condenser cooling service and general plant purposes. The water is taken from the stream through a trash rack and traveling screens that catch driftwood and other unwanted objects. The two screens are side by side and while one side is in service the other is cleaned by water directed at it from the back through a group of nozzles. The water is delivered under pressure by the I-R pump shown at the right.







STEAM CONDENSERS

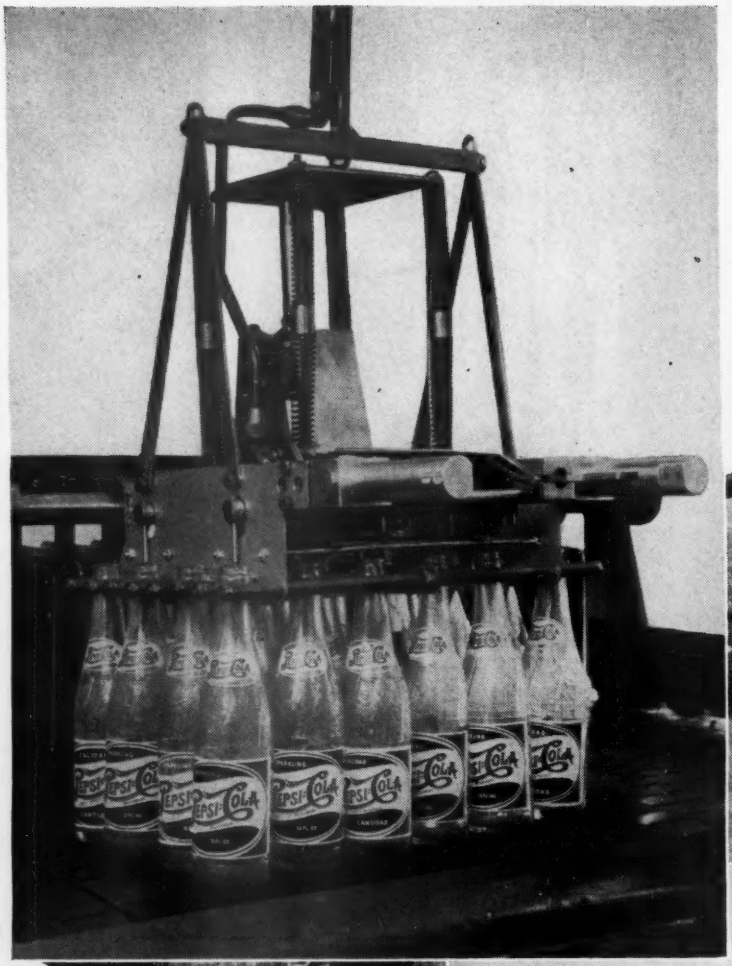
After its force has been expended against the hundreds of blades in a whirring turbine, the steam is converted to water in an Ingersoll-Rand condenser, one of which is located directly under each generating unit. The heart-shaped ends of the twin sections of the smallest of the condensers are shown above with its large-section connecting piping. Within the condenser, river water circulates through 26 miles of tubes having an aggregate exterior surface area of 27,500 square feet, while the steam is directed across the nest of piping and is consequently suddenly cooled. Entrained air and other gases are removed and a vacuum of 28 inches of mercury maintained within the twin condenser shells by the action of I-R 2-stage steam-jet ejectors (top-left). The condensate is returned to the boiler feed water circuit for reuse by one of the two I-R 500-gpm pumps pictured at the left.

ling's generators all operating equipment is protected against stoppage or faulty operation by every conceivable means. Electronic devices guide automatic controls, sound alarms when abnormal conditions exist, record operating variations that may precede trouble. Gauges, meters, instrument panels serving various units and groups of equipment are always within the sight of attendants. Duplicate standby equipment is ready to take over failures at strategic points. Auxiliary electric circuits lead to vital machines. Operators in the control room keep their fingers on the pulse of the plant and the transmission line. In front of them instrument bedecked control panels register all fluctuations and disturbances. An adequately equipped and staffed mechanical and electrical shop affords means of making quick repairs and adjustments to much of the equipment.

The safety and welfare of the workers is paramount at Hickling and is reflected throughout the plant. Good housekeeping, a prerequisite to safe and pleasant working conditions, is the watchword. Elevators, paging systems, the best of lighting, ventilating and heating systems add to the conveniences and comfort of all of the 65 employees. These features that may outwardly appear trivial and irrelevant to the function of generating electricity, are essential factors in the operation of a successful power plant.

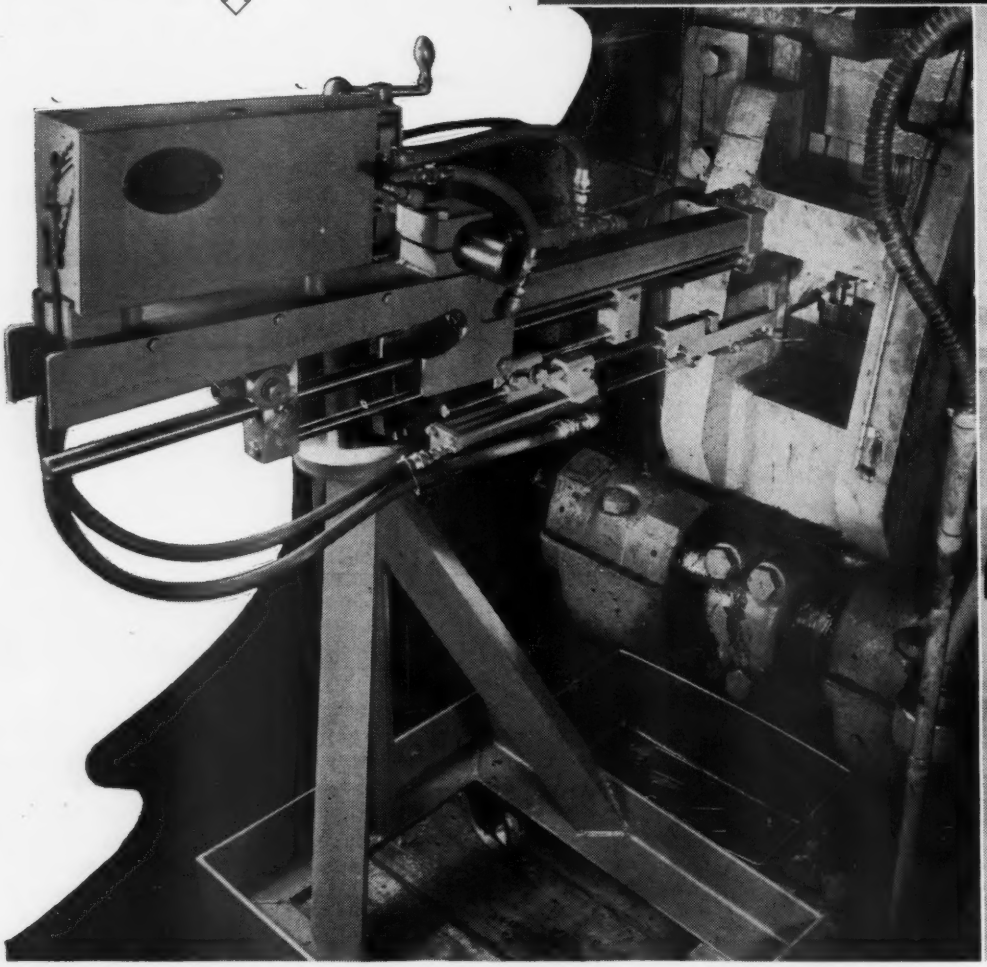
They are indispensable to a station that will provide its customers with a dependable supply of electrical energy and a high standard of service at the lowest possible price.

Ingeniously contrived machinery helps soft-drink makers continue to sell their products at a low price. Pictured is an air-operated bottle gripper depositing 24 bottles on a soaker feed table after having lifted them out of a case riding on a traveling conveyor belt. The gripping mechanism is actuated by an air cylinder, and the lifting is done by another cylinder mounted on an overhead trolley. The machine is made by Standard-Knapp, Portland, Conn., a division of Emhart Manufacturing Company.

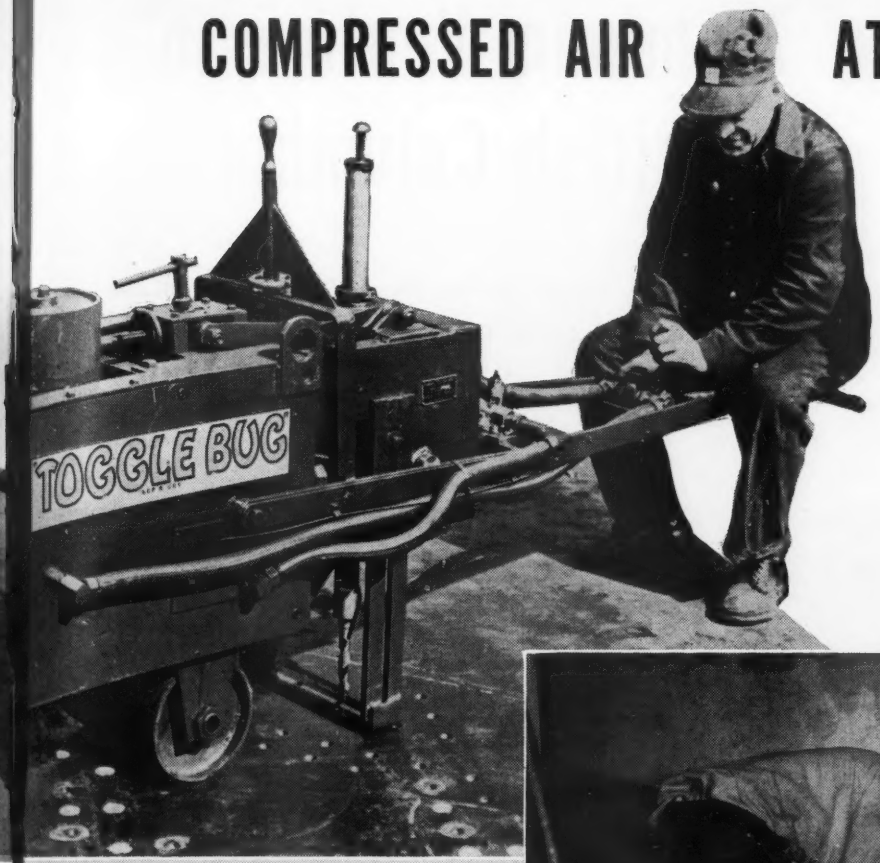


●

Actuated by an air cylinder, a steel jaw moves into the die of a metal press, grasps the part just stamped or sheared, retracts and deposits it in a tote box. The automatic mechanical unloader is mounted on a heavy steel frame that rides on caster-type wheels and can be moved about, if desired, from one press to another. Gripping jaws of various designs are provided for differing conditions. Jaw, air cylinder and electric controls are the same as those used on stationary Iron Hands produced by the same manufacturer, Sahlin Engineering Company, 267 Ferndale Street, Birmingham, Mich.



COMPRESSED AIR AT WORK



The Toggle Bug shown is used by Liphart Steel Company, of Richmond, Va., for drilling, reaming and countersinking holes up to 2¼ inches in diameter. This model of the handy, mobile units made by Guibert Steel Company, Pittsburgh, Pa., uses an Ingersoll-Rand 8.6-hp air motor to drive the tool. The speed can be varied as desired by either throttling or regulating the air pressure. Other advantages of an air motor in such an application are that it can't be damaged or burned out by overloading or stalling, and there is no possibility of short circuits or fires. Moreover, an air motor is economical to maintain and has a long service life.

In the Baldwin-Lima-Hamilton Corporation shops at Eddystone, Pa., fumes and sparks from welding operations are removed by more than 100 portable Lamb Air-Movers made by Mine Safety Appliances Company. When compressed air from a shop line is expanded at high velocity by passing through the annular orifice and outlet horn of one of these units, it draws along with it and away from the worker's breathing zone the atmospheric air within its reach. An Air-Mover weighing only 5 pounds and but 3 feet long will exhaust more than 4 cubic feet of air per second when supplied with compressed air at 20 psi pressure.

For the purpose of field servicing equipment used by contractors, strippers of overburden from coal seams and the like, The Cypher Company, of Pittsburgh, Pa., builds the truck shown here. It carries lubricants suitable for air compressors, power shovels, Tournapulls, trucks and other machines, as well as water, gasoline and other necessities. Mounted on a 20x63-inch air receiver near the rear is an Ingersoll-Rand 5-hp gasoline engine-driven compressor that supplies air at pressures up to 200 psi for operating lubricating equipment and inflating tires. The trucks have proved so popular that the manufacturer has outfitted a new plant in which to build them.

Aluminum Venture in British Columbia

Driving Ten-Mile, Large-Section Power Tunnel and Raises for Penstocks Constitutes Huge Drilling Job

H. R. Rice

Part 2

Power Tunnels

FOR delivery of water from the intake works at the west end of Tahtsa Lake to the turbines in the underground generating station at Kemano there will ultimately be two horseshoe-shaped tunnels with concrete inverts. Each will be 25 feet in diameter, 10.1 miles long and spaced 300 or more feet apart. An accompanying drawing shows these bores in plan and profile and gives pertinent information on elevations and slopes from the intake works to the tailrace at the Kemano River. No. 1, the more northerly, is now being driven, and the second one is to be undertaken whenever power demands warrant it.

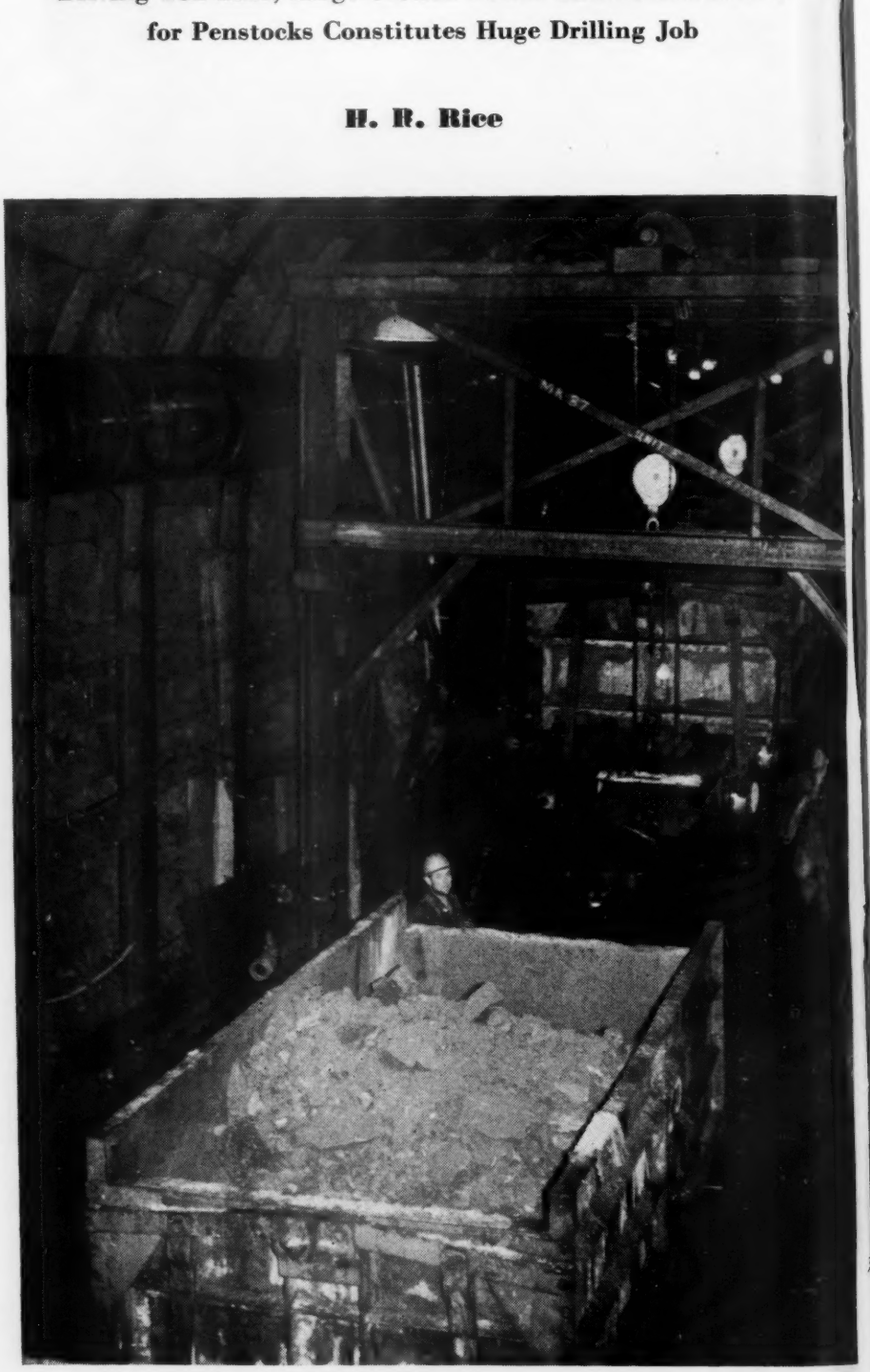
The design of the tunnels was selected after close consideration of engineering and economic factors, including friction losses and construction and operating costs. Friction losses and cost estimates were based on the use of steel supports and on a concrete lining for 10 percent of the total length, or wherever required for support or to cut off natural watercourses. A single bore of larger cross section would probably need much more support, and, in addition, the twin tunnels offer a greater factor of reliability.

No. 1 Power Tunnel has a cross-sectional area of 527 square feet, and with average overbreak the volume excavated amounts to about 23 cubic yards per lineal foot. It is being advanced from four headings: one from the intake end at Tahtsa Lake; two from an 1800-foot-long adit about midpoint in the Horetzky Creek Valley; and one from a portal at the west end above the Kemano River Valley.

When excavated, the bore will be paved with 6 inches of concrete not only for hydraulic efficiency but because it will be less expensive to do that than to remove all compacted muck from the floor. In order that the first three generating units may be placed in service in or about March, 1954, a coördinated series of dates has been set for the various phases of the rock-removal work. The latest date, that for the completion of the main tunnel exclusive of cleaning and paving, is October, 1953. For each of the four headings involved, this calls for an average advance of 27.1 feet per day on a 3-shift 7-day basis.

Geological Considerations

In general, the 10-mile tunnel extending from east to west will crosscut the formations of the westerly part of the Hazleton series of metamorphosed volcanics and sediments and a section of the coast range batholith. The exact location of the contact between these two main groups, or what will probably prove to be a wide contact zone, has still to be determined, but preliminary field work indicated it to be somewhere

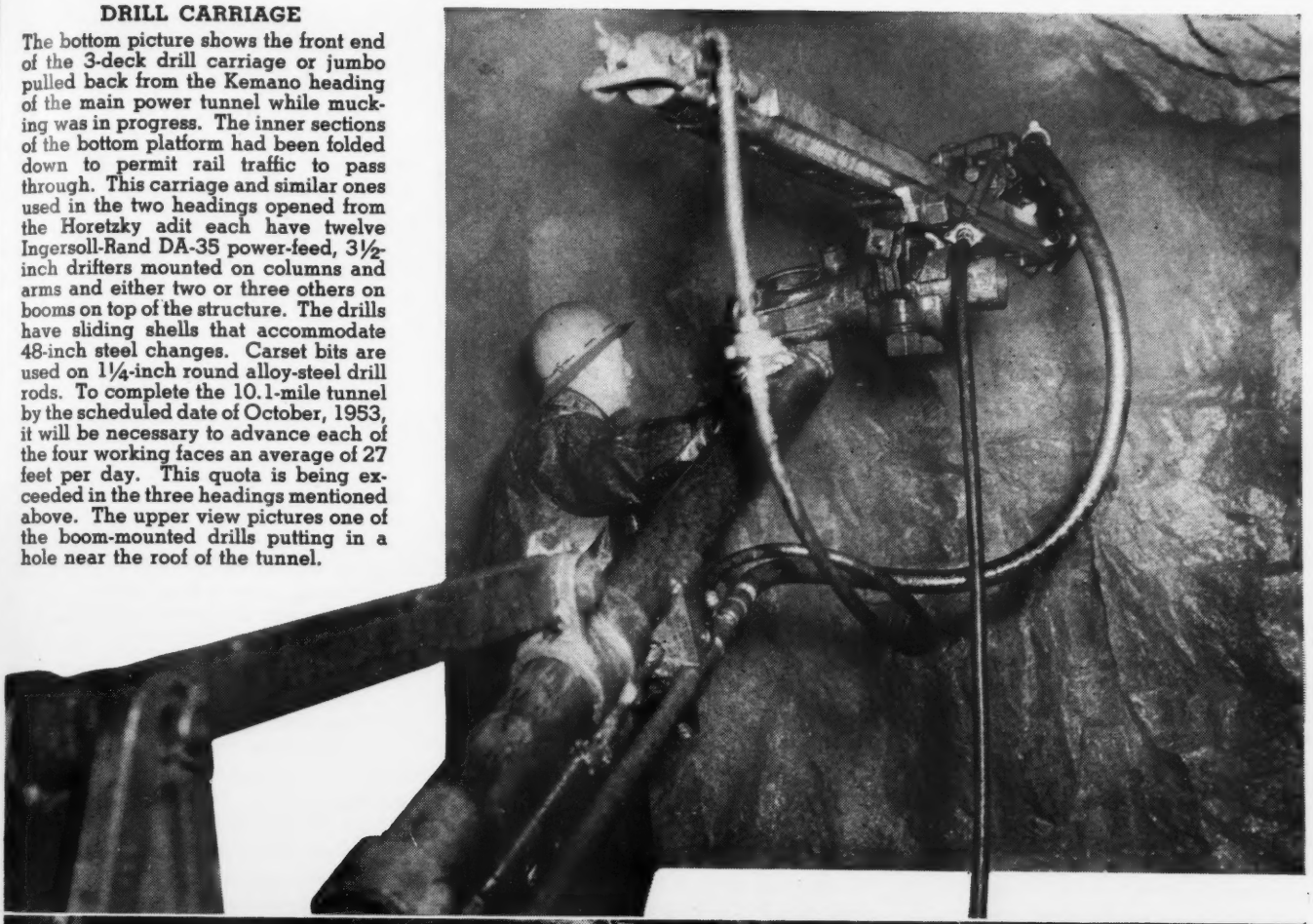


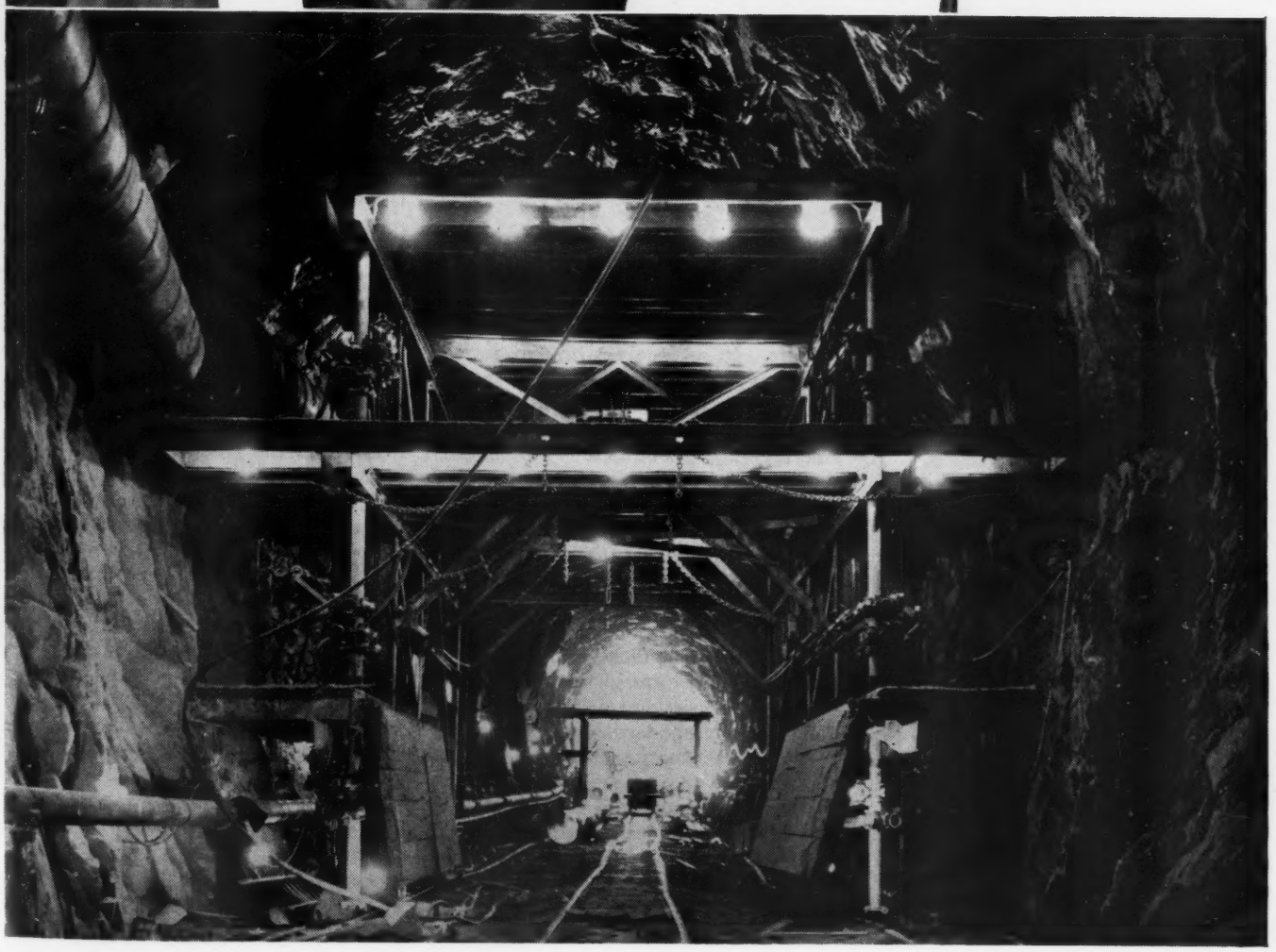
CHERRY PICKER

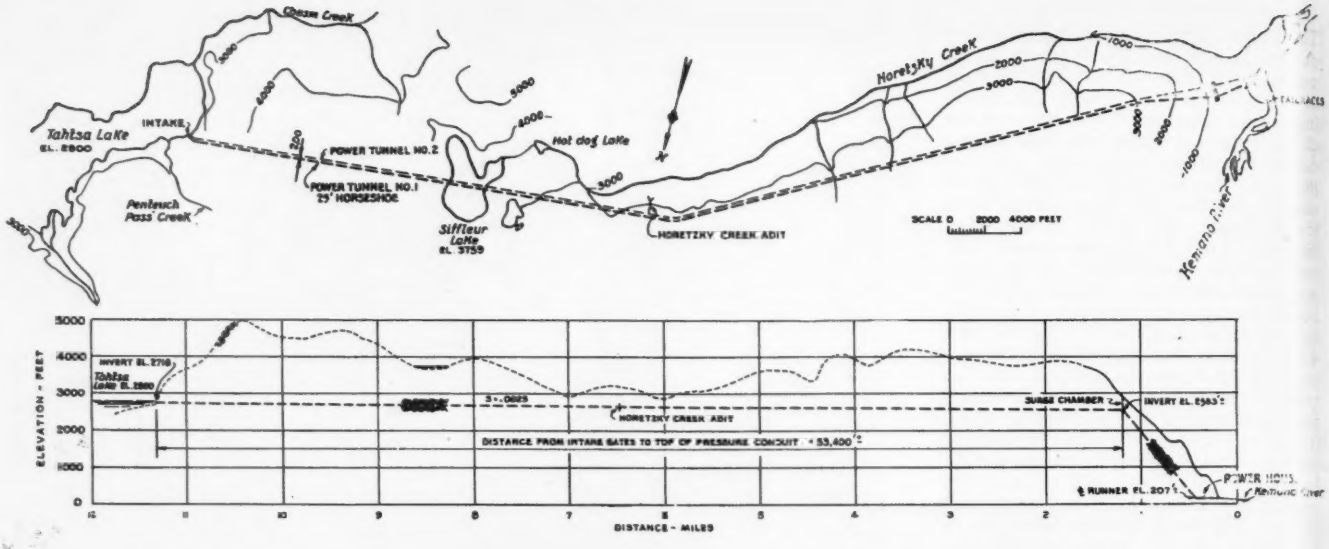
Built into the rear end of each drill carriage used in the Kemano and Heretzky headings is a hoisting device which, as shown here, lifts an empty car so that one that has just been loaded at the tunnel face can be shunted back underneath it. In this manner switching is accomplished with only one track. Lifting is done by an Ingersoll-Rand 10-hp air motor mounted overhead. The cars are of the Granby type and hold 6 cubic yards each.

DRILL CARRIAGE

The bottom picture shows the front end of the 3-deck drill carriage or jumbo pulled back from the Kemano heading of the main power tunnel while mucking was in progress. The inner sections of the bottom platform had been folded down to permit rail traffic to pass through. This carriage and similar ones used in the two headings opened from the Horetzky adit each have twelve Ingersoll-Rand DA-35 power-feed, 3½-inch drifters mounted on columns and arms and either two or three others on booms on top of the structure. The drills have sliding shells that accommodate 48-inch steel changes. Carset bits are used on 1¼-inch round alloy-steel drill rods. To complete the 10.1-mile tunnel by the scheduled date of October, 1953, it will be necessary to advance each of the four working faces an average of 27 feet per day. This quota is being exceeded in the three headings mentioned above. The upper view pictures one of the boom-mounted drills putting in a hole near the roof of the tunnel.







PLAN AND PROFILE OF POWER TUNNELS

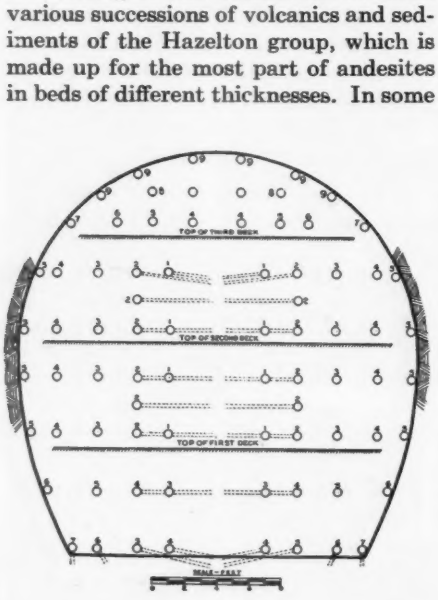
The first of the two projected parallel power tunnels is being driven from four points of attack with a heading at each end and two at the Horetzky Creek adit near midpoint. The bore will have a grade of a quarter of one per cent. It will be unlined except for the invert or floor, which will be concreted both to speed the flow of water through reduced friction and to avoid the excavating that would be required to clean up the bottom rock thoroughly.

in the vicinity of the Horetzky area. Exploratory operations consisted in making surface examinations, in putting down a series of diamond-drill holes at and near the Tahtsa Lake end, and in driving a crosscut through the powerhouse site at the Kemano end.

Tahtsa Area

Diamond drilling and examination of the outcrop at the Tahtsa end revealed various successions of volcanics and sediments of the Hazelton group, which is made up for the most part of andesites in beds of different thicknesses. In some places, strata of andesites and other rocks are separated by tongues of granite and, again, by veins of chlorite and epidote.

The rocks show considerable jointing and variation in composition and texture, though experience gained so far in the tunnel work bears out the expectation that they possess considerable strength, durability and tightness. It is therefore unlikely that they will offer serious difficulty as to excavation or support. Their drilling qualities are superior to those of the batholithic rocks of the Kemano area and, judging by present indications, they also break easier.



POWER-TUNNEL DRILL ROUND

Although subject to minor variations, this is the typical hole-arrangement pattern at the three headings being driven with DA-35 drifters. The levels of the three decks of the drill carriage are indicated. The 74 holes average 13 feet in depth and call for a total of about 966 lineal feet of drilling. Approximately 23 cubic yards of rock is broken and removed per lineal foot of advance. The figures show the order of blasting, using seven delays of detonators.

Horetzky Area

The rocks exposed in driving the access tunnel at the Horetzky halfway point are of the Hazelton group composed almost entirely of andesites and basalts. In advancing the adit it was necessary, doubtless because of the alteration effect of surface waters, to provide support in the form of prefabricated steel sets throughout its 1800-foot length. At the junction of the access tunnel and the main bore the rocks appeared much fresher and indicated a more general and stable condition from that point on.

Kemano Area

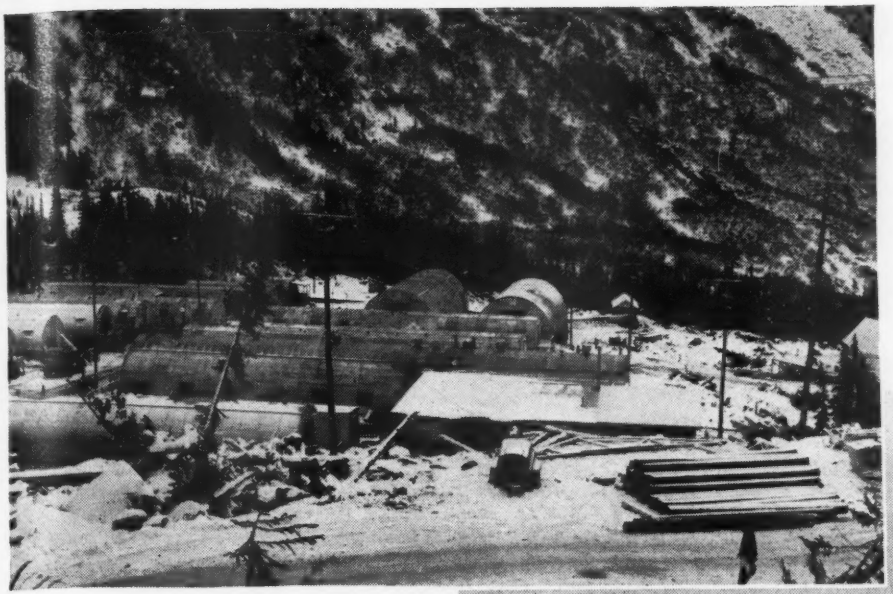
The excavations for the powerhouse, penstock works, and the west heading of the main tunnel are in the coast-range batholith, consisting generally of quartz diorite and granodiorite with some exposures of pegmatite dykes as well as rocks of a dioritic nature. In the quartz diorite and granodiorite there is quartz in varying abundance, with feldspars and intermediate plagioclases making up the bulk. The principal accessory minerals are hornblende, orthoclase, microcline and biotite, and all but the latter minerals are present as medium to large crystals. The rocks, for the most part, are therefore strong and, except for joints and minor faults, offer homogeneous resistance to deforming stresses.

More or less pronounced and complementary sets of joints have resulted in the vertical and overhanging cliffs which characterize the Kemano area. Except in places where occasional watercourses follow the more marked of these joints and where the leaching action of the surface waters has led to alteration, no difficulty has been experienced so far either in driving or supporting those parts of the workings that lie in the batholithic rocks. It is reasonable to expect that this condition will continue at least to the zone of contact with the Hazelton series. In drilling and blasting the rocks are found to be fairly abrasive (hardness varying with the amount of quartz present), free drilling, and fairly resistant to breakage.

The British Columbia Department of Mines and the Geological Department of the University of British Columbia are aware of the fact that the project offers them a unique opportunity to examine a freshly excavated crosscut extending through the coast-range batholith and contact zone into the Hazelton group of rocks. During the present and the next summer season geologists will study the exposed surfaces, and the findings are bound to give a great deal of valuable fundamental information on the various aspects of general geology, petrography, rock alteration and structure.

Tahtsa Lake Heading

Access to the Tahtsa Lake end of Power Tunnel No. 1 is gained through a 17-foot-diameter adit driven for a distance of 1134 feet on a downgrade vary-



HELICOPTER SERVICE

Horetzky camp (left) is located midway of the power-tunnel line and reached from Kemano by a 7-mile road that traverses rough country. In winter the route is often blocked by snowslides, and then travelers resort to helicopters. Two of the craft are shown below at Kemano when that camp was in an early stage of construction.

ing from 2½ to 4½ percent in order to meet the invert elevation at the intersection. The main heading between this intersection and the intake works proper will be driven later.

Drilling practice in the 25-foot-diameter heading differs from underground rock work at other locations in that it involves the use of air-leg-mounted drills. An accompanying diagram shows how drilling is allocated among sixteen machines mounted on a 3-deck cherry picker-jumbo. The drills are equipped with chisel-bit drill rods with tungsten-carbide inserts set integrally in the upcast end and with a starting gauge of 1.34 inches. Another departure from procedure at Kemano and Horetzky is found in blasting. At Tahtsa, instead of wiring caps individually to a buss-wire system, groups of nine or ten holes are wired in series to the two main wires.

From the main base camp at Kemano the operations at Tahtsa are accessible only by aeroplane or helicopter. To the east, a barge line runs 20 miles to East Tahtsa, which has been connected by a 110-mile road with Burns Lake, a station on the Canadian National Railway. Camp facilities, air compressors, equipment for generating power, as well as complete maintenance shops, are located in Tahtsa.

Horetzky and Kemano Headings

Apart from the Tahtsa section just referred to, all underground rock work on levels is drilled with 3½-inch power-feed drifters instead of air-leg-mounted drills in order to take advantage of the increased rate of advance and longer rounds possible with machines of this size. The drifters are provided with shells permitting a 4-foot steel change, and there is a centralizer for collaring.

Drill steel is 1¼ inches in diameter, round in section and cut in lengths of 5 feet 8 inches, 9 feet 8 inches, and 13 feet 8 inches. The 4-winged detachable bits tipped with tungsten carbide have a 2-inch gauge when new and are used as starters. After successive regrinding they are sorted at gauge intervals of 1/16 inch for work on the second and third drill runs. The ground is granodiorite, and typical speed of penetration is in the range of 17 to 23 inches per minute. Air is discharged at 100 psi by the compressors and delivered to all machines at a minimum pressure of 95 to 100 psi.

An accompaying drawing shows the basic drilling pattern followed in the Kemano and Horetzky headings. This pattern is for general guidance, for, like in all tunnel operations, the immediate supervisory staff can, with discretion, vary the number and arrangement of the holes to some extent. It will be noted that a double "V" cut is commonly used throughout all narrow workings and that both cuts and square-ups are blasted at one time. In the Horetzky and Kemano headings on the main bore, as well as in all close-quarter workings in connection with the powerhouse, holes are wired individually to a main buss-wire system.

Also indicated in the basic drilling pattern is the decking arrangement of the cherry picker-jumbo designed and fabricated for this job. The carriage is divided into two main compartments, the front or face section and the back or cherry-picker half. The front compartment is rigged for the column-and-arm mounting of twelve 3½-inch power-feed drifters and the hydraulic mounting of two or three similar drills on the top deck.

The cherry-picker is fitted with a 10-hp hoist and is used in clearing operations to effect rapid changing of cars at the face. The jumbo travels on its own gantry rails of 14-foot gauge and is moved by 8-ton storage-battery locomotives. The latter are equipped with a trolley post, and as the length of the tunnel increases beyond the economic scope of the batteries a 440-volt trolley line will be carried into the heading.

Mucking is done with a 100-hp electric bucket-conveyor loader which delivers to 6-cubic-yard Granby-type cars that are changed at the face by the cherry-picker. When full, they are spotted on a siding maintained within 1000 feet of the face for gathering and hauling to dumps situated outside the portal.

Access to the main bore at the Horetzky halfway point is gained through an adit driven full heading from its portal for a distance of 1800 feet. It is supported virtually throughout its entire length with steel sets fabricated from 8-inch H-beams. The camp at Horetzky is reached from the main Kemano camp over a 6-mile road that was constructed for the purpose. Because occasional sea-

THE ROAD TO KEMANO

1

2

3

These pictures portray some of the difficulties encountered in building access roads in the rugged British Columbia terrain.

1 A partly excavated gash on the precipitous mountain slope is seen near the bottom. All the other views are close-ups in this same general vicinity.

2 A drilling crew and a shovel getting riprap out of an improvised roadside quarry.

3 A drilling crew putting toe holes in a cliff in a wintry setting.

4 An I-R portable air compressor on a wooden skid is stationed at a hairpin turn in a switchback used to climb the steep hillside.

5 An advance guard carving a ledge along a sheer cliff. Note the air hoses coming down from above.

5

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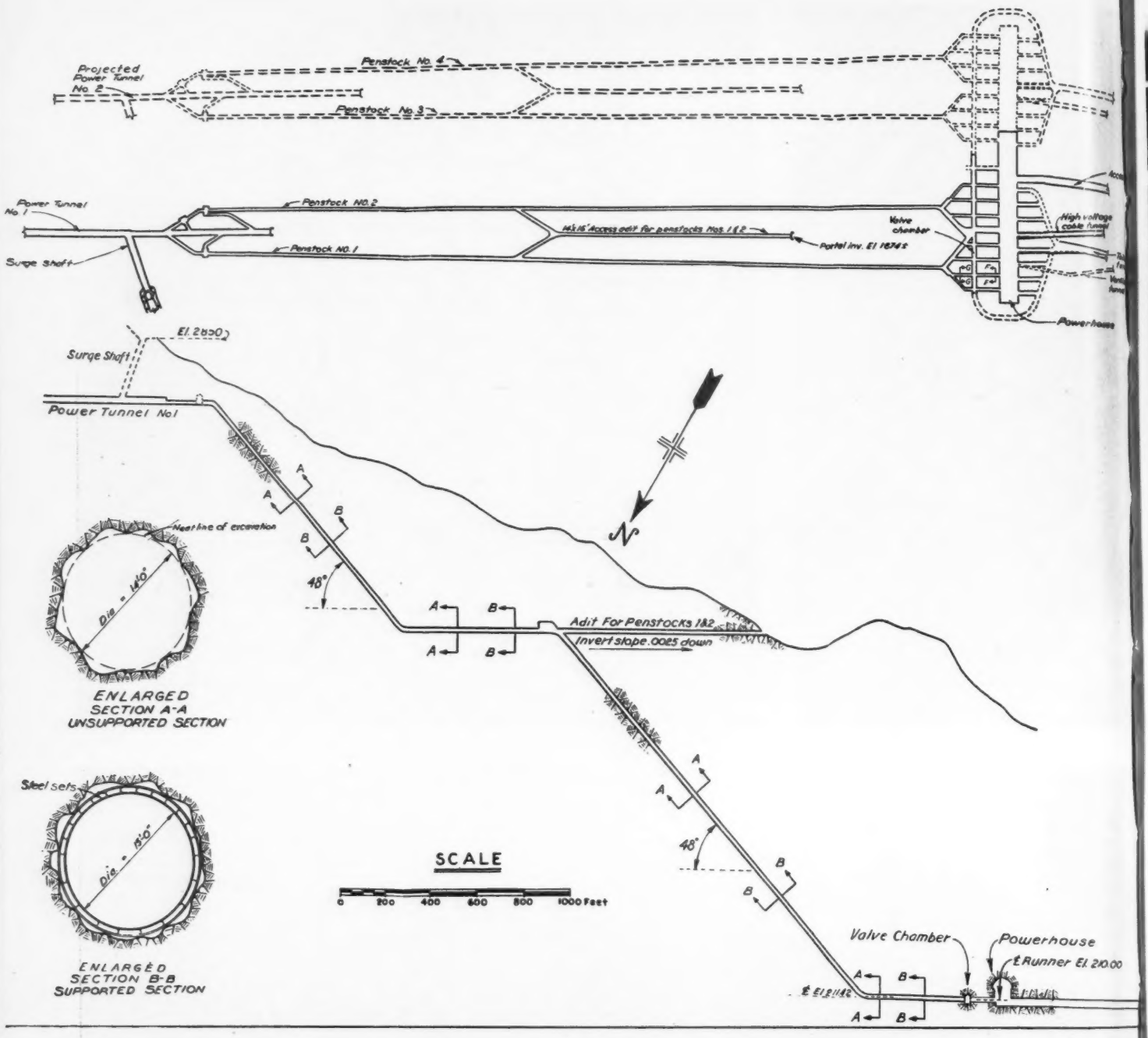


PENSTOCK AND POWERHOUSE EXCAVATION SKETCHES

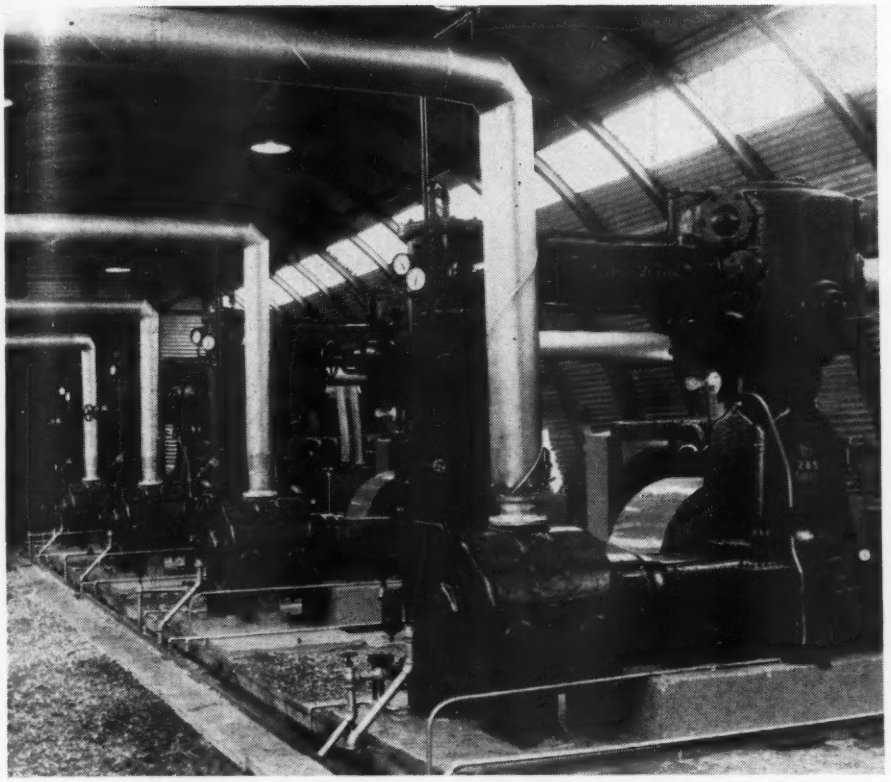
Plan and profile showing the general relation of the penstocks to the power tunnels and underground power plant. The two tunnels will be spaced about 300 feet apart and each will normally carry 3500 cubic feet of water per second though designed for a maximum of 4500 cfs. As shown, there will be a surge chamber or shaft near the outlet end of each tunnel, and downstream from that point the bore will branch into two 11-foot-diameter pressure conduits about 4000 feet long each serving four generating units through 5-foot-diameter branch pipes. The penstocks will have a slope of 40°, with a 500-foot horizontal offset at the midway point. The 14-foot tunnels for them are being excavated by working upward from the powerhouse level and also from the adit level approximately 1600 feet higher. These raises are being driven mainly with Canadian Ingersoll-Rand CR-58 stopehamer drills. Carset bits are employed here, as they are generally throughout the job on drifters, Jackhamers and wagon drills.

sonal snowslides affect the reliability of this line of communication, the camp maintains an ample supply of stores and is completely equipped with shops, compressors and power-generating units.

The heading at the Kemano end is being pushed forward from a portal at about Elevation 2600 above the powerhouse workings. The camp near this portal offers living accommodations only because it is served with everything, including compressed air and electric power, from the base camp at the foot of the mountain by an aerial tramway that runs in a clearing, now a conspicuous feature of the valley. The tramway, which also serves a portal on the 1600 level, can carry a 30-ton load and is operated by means of a 96-inch double-drum hoist powered by a 350-bhp induction motor. The pull line consists of 11,800 feet of 1⅜-inch rope arranged as a main-and-tail system, and the two track cables are 2½ inches in diameter.

Penstock Workings

From the 2600 level the No. 1 Power Tunnel will branch off into two steel penstocks shown in plan and section in an accompanying drawing in relation to the power-plant ancillary workings. The arrangement will be duplicated as and when the No. 2 Power Tunnel is taken in hand. The water will be divided between the 11-foot-diameter penstocks, each of which is to be carried in a 14-foot-diameter, backfilled and grouted



COMPRESSORS AT HORETZKY

Four Canadian Ingersoll-Rand Type XVH air compressors at the Horetzky adit. In the absence of power lines, they are driven by General Motors diesel engines. Each compressor has a capacity of 1100 cfm. Eighteen stationary machines of this type are scattered over the job in addition to more than twenty I-R portable compressors of various sizes. The major use of compressed air is for operating rock drills, but appreciable quantities are also consumed by hoists, sump pumps, drill-steel furnaces and sharpeners, Jackbit grinders and pneumatic tools.

raise. It will be controlled by an oil-actuated butterfly valve installed a short distance below the wye branch, and an air-inlet valve will be included so that air may be admitted whenever it becomes necessary to drain the penstock for inspection and maintenance.

Each raise is being driven on a 48° slope from two headings, one from the powerhouse invert elevation and the other from an adit at Elevation 1676 where there is a horizontal offset of about 600 feet for constructional convenience. One section extends for a distance of 1980 lineal feet to the 1600-foot level and the other 1275 feet from that point to the 2600 level. At the time the project was visited, actual work had not been begun, but the plan was to drive 6x8-foot pilot raises and subsequently slash them to the neat lines by drilling from a jumbo designed for the purpose.

At the turbine elevation each penstock will deliver to a wye manifold with symmetrically arranged 45° offsets and four 5-foot-diameter branch pipes. Each of the turbine inlets will be controlled by a spherical valve and will serve one 140,000-hp unit. The inlets are to be enclosed in 9-foot-diameter circular tunnels backfilled with concrete.

In order that the penstocks, manifolds, and turbine branches might be equal to the pressure of 1236 psi created by the operating head and surge, these facilities have been carefully designed and subjected to intensive study, including an investigation of the modulus of elasticity of the enclosing rocks—work that merits a brief description. It was necessary to determine this factor so as to compute the relative proportion of the imposed load to be carried by the steel and by the surrounding rocks. Also one of the considerations that led to the selection of an underground site for the powerhouse and penstocks was the need of holding in check the high hydraulic pressures developed in an installation of the size contemplated.

To obtain the desired information, a spherical chamber was cut in the quartz-diorite rock at a point 25 feet away from the wall of and 15 feet below the floor of an exploratory tunnel that had been driven during the early stages of the project. In it was put a hollow steel ball 10 feet in diameter and having walls ½ inch thick. The chamber was then backfilled with concrete and grouted.

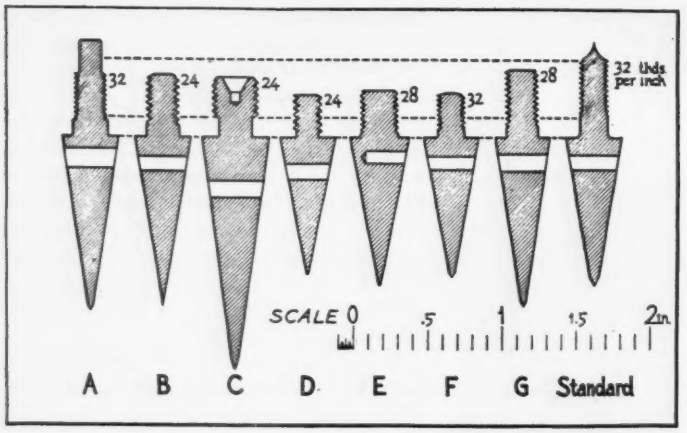
With diamond drills, twenty-six 3-inch holes 55 feet long were drilled from the sphere through points on the periphery on meridians and latitudes 45° apart. To establish the diametric strains in the steel shell, six radial steel rods were placed in the ball and Carlson gauges were set in the drill holes at points 10, 25, 40 and 55 feet from the periphery of the sphere. The latter was next filled with water and the various strains were recorded at intervals as the pressure was increased from zero to 3600 psi.

As a result of this investigation it was indicated in advance that the bulk modulus of elasticity of the rock was in the order of 1,500,000, a figure that confirmed those given by most authorities for granitic rocks.

(To be concluded)

MUCKING MACHINE

A Conway 100-hp, electric-driven loader used to handle muck at tunnel headings. Broken rock is scooped up by the bucket and dumped backward onto a belt that conveys it to a car.



REPLACEMENT POINTS

Imagine the trouble you would have if each manufacturer of light bulbs designed the screw base according to his own ideas. You would then have to search for the particular kind that would fit your sockets. Something akin to this plagues the shopper for plumb-bob points. A few of the variations are pictured. The proposed standard point is on the extreme right.

Standardized Plumb-Bob Points

James Hirt

STANDARDIZATION of plumb-bob points is the goal of the Service and Supply Department of the California Division of Highways and a Standardization Committee composed of civil and mechanical engineers, manufacturers and distributors. One or more bobs are used by every survey crew to transfer a point on the ground to a point some distance above it, or vice versa, and a transit is centered over the survey point on the ground by means of a plumb bob. Chainmen use them in order to measure ground points with a tape supported only at the ends.

Normal service not only results in worn, damaged, or broken points but occasionally also in lost bobs, necessitating replacement. Also, a point is often used as a scribe to mark a point on a rock or concrete, a common cause of wear. That there is need of a standard plumb-bob point has been emphasized by the great variety now being manufactured and the difficulty experienced in replacing them. It is estimated that the several hundred thousand precision bobs produced in the United States each year range in weight from 4 to 96 ounces, with the 10- to 16-ounce type the most popular. Different thread sizes and threaded connections, varying major nominal diameters, numerous kinds of points (anywhere from an easily broken needle point to a very blunt and therefore inaccurate point) and many sizes of drill holes, all contribute to the problem of correct replacement.

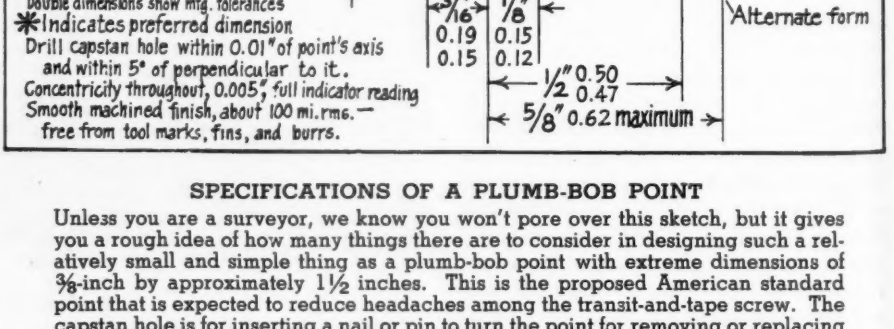
Usually, the manufacturer's or distributor's name is marked on a bob, but as the latter is made of brass the name is often obliterated. With no means of identification, a surveyor will very likely have to trust to luck if he wants to continue using the bob and can't give the catalogue number or spare the point as a sample to be sent to the supplier. The distributor therefore has to submit samples from which the surveyor can select a point to fit his bob. Even when the manufacturer is known there is no guarantee that the points ordered will fit, because one distributor has furnished bobs with three different points within a 10-year period. All this trouble and delay increases the supplier's overhead and wastes the surveyor's time.

To obviate the difficulty, and to develop a point satisfactory to all concerned, the Standardization Committee has submitted a tentative standard to the National Bureau of Standards. Several American manufacturers are already producing replacement points conforming to its specifications. In brief, the committee's standard calls for a plumb-bob point with a major nominal diameter of ⅜ inch because 90 percent of those made today are of this size. A No. 40 hole, drilled clear through, is specified. Although this is larger than that generally adopted, it will permit the use of more readily available pins or nails for removal or installation. The threaded connection, the part which has varied the most and has caused much confusion and delay in obtaining replacements, has a 10-32 thread.

Don't you dare shoot any birds with that thing, young man!

Only the form of the bob point is dealt with in this tentative standard, nothing is said about the kind of material of which it is to be manufactured. However, the Service and Supply Department plans to prepare specifications covering the entire plumb bob so that not only the point but also the bob, the cap and all materials used will be standardized.

Acknowledgment is made to "California Highways & Public Works" as source of material.


Capstan hole (for 3/32" dia. nail or pin) No. 40 drill, through
1/16" dia. 0.07 0.06
3/8" dia. 0.370 0.365
3/16" dia. 0.191 * 0.186
1/32" rad. 0.04 0.02
15° * or 22° thread chamfer
10-32 NF 3 except one starting thread
60° ± 4°
20° ± ½°
45° minimum
Preferred form
Alternate form
3/16" 0.19 0.15
1/8" 0.15 0.12
1/2" 0.50 0.47
5/8" 0.62 maximum
NOTE —
Double dimensions show mfg. tolerances
* Indicates preferred dimension
Drill capstan hole within 0.01" of point's axis and within 5° of perpendicular to it.
Concentricity throughout, 0.005", full indicator reading
Smooth machined finish, about 100 mi. rms. — free from tool marks, fins, and burrs.

SPECIFICATIONS OF A PLUMB-BOB POINT

Unless you are a surveyor, we know you won't pore over this sketch, but it gives you a rough idea of how many things there are to consider in designing such a relatively small and simple thing as a plumb-bob point with extreme dimensions of ⅜-inch by approximately 1½ inches. This is the proposed American standard point that is expected to reduce headaches among the transit-and-tape screw. The capstan hole is for inserting a nail or pin to turn the point for removing or replacing it. This tentative standard has not yet been adopted but some manufacturers are already following it.

Flameless Welding

HOT-AIR GUN

Heated compressed air issuing from the nozzle quickly softens low-melt plastics and makes a variety of "welding" jobs possible. In the view above, the edges of a thermoplastic sheet are being heat-sealed to produce a sleeve. The stock is held between two bars of metal that mask it and limit the width of the sealed seam. The other picture shows a Hot-Jet gun fusing a filler rod in the process of welding and assembling a pair of thermoplastic moldings.

IN WELDING, heat-sealing, spot-heating and "brazing" low-melt plastics, such as polyethylene, polyvinyl chloride, polystyrene and Lucite and Plexiglas acrylics, care must be taken to prevent burning or oxidizing of the materials. For work of this kind, DeBell & Richardson, Inc., has developed a Hot-Jet process that depends for its effectiveness on a flameless jet that is created by heating compressed air and issues from a hand-held gun with a glass-lined, stainless-steel nozzle. In addition, the method involves the use of a compressor delivering air at a maximum pressure of 300 psi; a regulating valve to reduce the line pressure to 5-60 psi; and a Powerstat rated at 7½ amperes, 115 volts, 60 cycles alternating current to convert power from a transmission system into the voltage required for different heating operations.

The air flows through a series of passages in a hermetically sealed housing that provides 227 inches of heat-exchanger surface. On its way to the nozzle it is progressively heated by means of a "cartridge" which receives electrical energy from the Powerstat. The heat-transfer efficiency of the equipment is rated at 60 to 70 percent, which is more than three times that of the average automobile engine. However, an English firm is reportedly designing a small ultrasonic siren with more than 90 percent efficiency that may serve the same general purpose. Output pressures and temperatures of the gun are regulated in accordance with the dimensions and melting points of the materials and the operating conditions.

Plastics are prepared for Hot-Jet processing much the same as metals are made ready for welding with gas or electric arc equipment; that is, by cleaning or degreasing the surfaces which must be heated and by beveling or spacing components where neat assembly joints are required. Then, if necessary, the device may be used like a gas-welding torch to fuse a filler rod so as to mate materials or parts.

Thermoplastic sheets, tubes, and other shapes as well as materials with a thickness of 1/16 inch and upward have been satisfactorily joined, and for most purposes the fillers have consisted of 3/32-inch-diameter rods of the same chemical make-up as the plastics handled. Welding speeds have ranged from about 3 to 6 inches per minute, depending upon the rate of heat transfer which varies with materials of different compositions and dimensions.

Where heat-sealing has been specified for such operations as sandwiching photographs and identification cards between layers of transparent plastics, Hot-Jet guns have been used to provide the necessary vertical pressure and temperature to fuse the stacked laminates.

Thermosetting plastics, or substances which cannot be resoftened after they have been solidified with heat, are not as suitable as thermoplastics for the Hot-Jet process. However, thermosetting or synthetic-enamel coatings can be readily solidified after they have been applied in the conventional manner if they are exposed to "hot air" with relatively little pressure. And heat-cured moldings of plastic of this kind have been quickly bonded together by use of the flameless jet to set or cure adhesives on their mating surfaces. Incidentally, Hot-Jet guns are desirable assembly tools for all types of plastic moldings and casts because they make it possible to weld relatively simple parts into intricate products, thus eliminating the need of costly and complex molds or dies.

The maximum heat output of the gun rarely exceeds 650°F at a point ¼ inch from the nozzle. This cannot normally be used in work with metals (some will fuse at much lower temperatures) because the oxygen in the air may cause undesirable reactions in molten alloys. However, tests have shown that Hot-Jet equipment can be operated with an inert gas such as nitrogen or carbon dioxide instead of air, so that certain low-melt materials, lead-bismuth alloys, for example, can be welded or liquefied without danger of oxidization. Therefore, it is not unreasonable to expect that Hot-Jet guns will eventually be used in connection with special accessories for purposes for which they are not now regarded as practical—such, perhaps, as applying coatings of thermoplastics and metals whose temperature resistance obviates the use of standard hot-spray equipment.

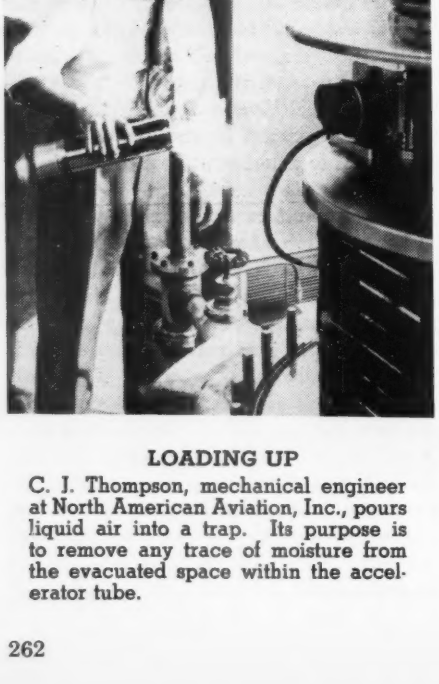
THE STATITRON

STATITRON is a name that has been coined for an unusual combination of pneumatic and electronic equipment being used at North American Aviation, Inc., Los Angeles, Calif., to improve the quality of aircraft materials and parts. In principle, the unit may be described as the first commercially practical version of the Van de Graaf electrostatic generators used by nuclear physicists at the Brookhaven, Argonne, Oak Ridge, and Los Alamos national laboratories. However, its purpose is to rearrange—not to smash—the atoms in material substances by converting ordinary electrical current into a high-voltage electron beam comparable in some respects to the output of an X-ray machine.

The operation of the Statitron involves the following steps in the order in which they are listed:

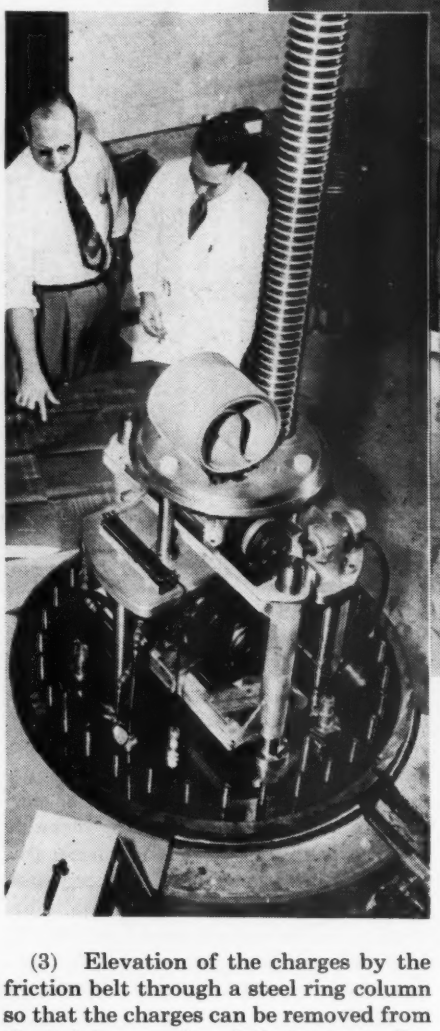
(1) Conversion of alternating current from a factory power line into direct current by means of a conventional high-voltage transformer and rectifier in order to energize a series of charging needles.

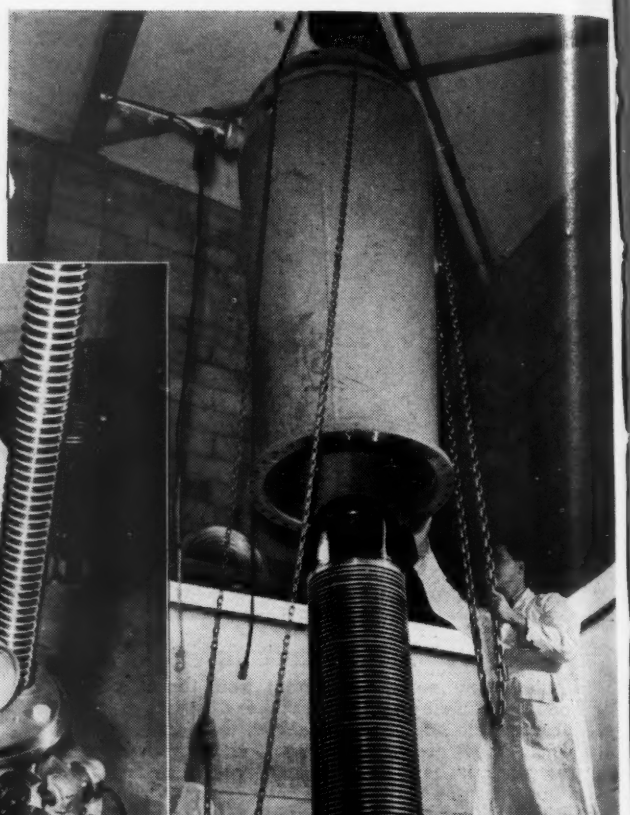
(2) Transfer of high-voltage electrostatic charges from the needles to a friction belt, which is vertically mounted on a pair of rollers and rotated by power transmitted from an electric motor through the lower roller.



LOADING UP

C. J. Thompson, mechanical engineer at North American Aviation, Inc., pours liquid air into a trap. Its purpose is to remove any trace of moisture from the evacuated space within the accelerator tube.





PUTTING IT TOGETHER

At the left is the base of the Statitron and, rising from it, the accelerator tube through which electrons are fired at a target with the speed of light. Alongside the bottom of the tube is the friction belt that is wound up through steel rings assembled around the accelerator tube, as shown in the view above. The tank that is being lowered into position as the final assembly step was later charged with air at a pressure of 200 psi.

(3) Elevation of the charges by the friction belt through a steel ring column so that the charges can be removed from the belt by a series of discharge needles and accumulated in a dome at the top of the column.

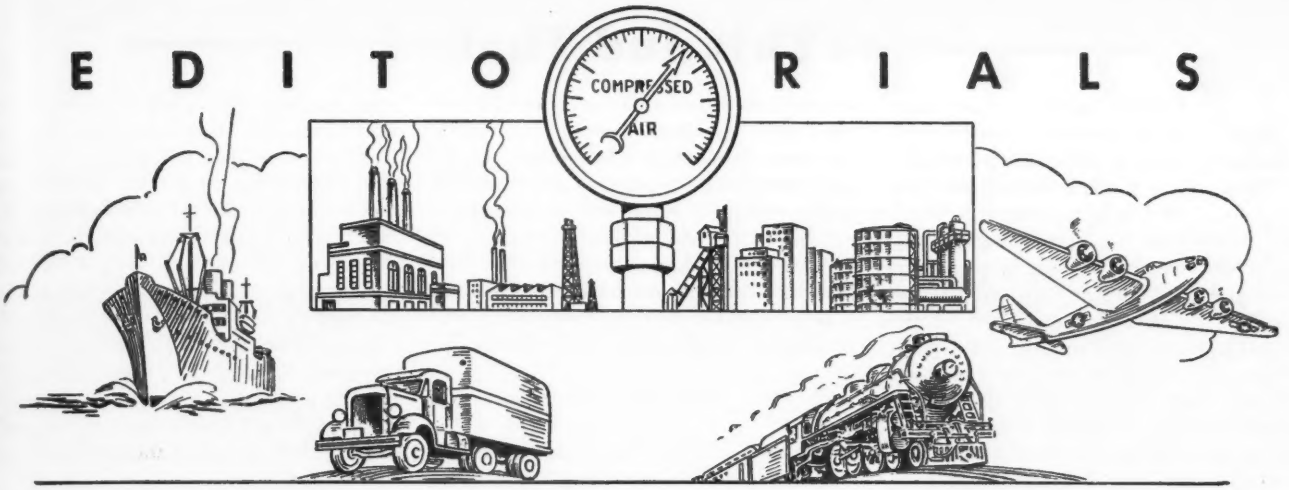
(4) Acceleration of the accumulated electrical particles in the dome by a special generator, transformer, and filament to shoot them through a vertical tube at a target below the base of the Statitron.

As many as 60 thousand billion electrons per second can be fired with the approximate speed of light (186,000 miles per second) in the process of bombarding the target. This involves the use of pneumatic equipment, first, to evacuate the vertical accelerator tube and, second, to maintain dry-air operational pressures of 200 psi in a cylindrical tank which houses the Statitron when in service. Positive and negative pressures are required to assure the effective use of the input electric power.

Specific applications for the Statitron cannot be discussed because of national-security regulations. However, Dr. Donald Eggen, physicist in charge of the project, has provided the following general explanation of at least one important service: "If you take a thin piece of metal and bend it back and forth several times, it eventually gets hard and breaks . . . . With the Statitron, we can get the same effect; and, in addition, we can find out why the metal breaks."

Compared with the electrostatic generators used in producing A-bombs, the Statitron is exceptionally inexpensive and compact. It is only 9½ feet tall and has a maximum diameter of 40 inches when fully assembled. The unit is installed in a specially insulated room and operated by remote control by engineers outside of the room. While the machine produces no radioisotopes or materials with lingering radioactivity, it does create invisible electronic radiations that greatly exceed the radiation tolerance of the human body.

EDITORIALS



THE WATER PROBLEM

WATER is without doubt the most essential substance in the universe. When too much of it falls to the ground, we have disastrous floods such as those that struck the Missouri Valley last spring. Conversely, when Nature is niggardly with precipitation, the land parches and crops are dwarfed, as has been the case in the Middle South and New England in recent weeks.

Water is the key to agricultural success and all human endeavor is dependent on an adequate food supply. In the semiarid West a good water right, i.e., a prior claim on water flowing in an irrigation canal serving the property, is the most valuable adjunct a tract of rural land can possess. Because of the imbalance in the natural distribution of moisture, great construction undertakings costing millions of dollars have been launched to transport water long distances, even through mountains. The Central Valley Project in California and the Colorado-Big Thompson Project in Colorado are outstanding examples.

Some of our big cities have reached far into the hinterland for water. Los Angeles and its environs, with their aqueduct that carries the precious fluid nearly 300 miles from the Colorado River naturally come to mind here. Across the continent we find New York going farther and farther into the mountains to keep pace with the growing demand for water. Its water department has been engaged more than half the time during the past fifty years in construction designed to augment the supply. For more than ten years now it has been building dams, tunnels and other works on the upper reaches of the Delaware, a stream to which some New Jersey and Pennsylvania cities, notably Philadelphia, also are looking as a future source of water.

Water is so vital to national defense preparations that the Federal Government has established a Water Resources Division to serve as a clearing house for information on water resources for industrial, public and domestic purposes as well as on the disposal of sewage and industrial wastes. This agency has authority to pass on applications made to the National Production Authority for materials needed for water supply and sewerage construction and it has allotted large quantities of steel, copper and aluminum for these purposes.

For the want of water, defense production has been seriously curtailed in several sections. In Wichita, Kan., breaks in the main water supply line idled 50,000 workers in airplane factories for several days. Lack of rainfall on the Canadian River watershed threatened the development of a serious situation in Oklahoma City and it was averted by quickly making available 10,900 feet of pipe with which to tap a supplemental source of water supply.

The President's Materials Policy Commission's report, better known as the Paley report, put the spotlight on the essentiality of water for industrial operations and revealed some startling facts. It disclosed, for instance, that eight times as much water was used by industries in 1950 as in 1900, although the population only doubled during the same period. This is explained by the fact that many of the newer industries that have sprung up during the intervening years are heavy water users. By way of illustration, it is estimated that 1,050,000 gallons of water is required to produce 1000 barrels of aviation gasoline, and 15,800,000 gallons to turn out 1000 gallons of synthetic gasoline. A ton of rolled steel requires 80,000 to 110,000 gallons, a ton of sulphate paper pulp 64,000 to 70,000 gallons, and a ton of viscose rayon from 180,000 to 200,000 gallons.

The report points out that it is less expensive to locate industrial plants near a good source of water and transmit electrical power a considerable distance than vice versa. Studies indicate that a 26-inch water line calls for eight times the material and ten times the money that are needed to build a power line with capacity to serve a fair-sized factory.

Pollution is an important aspect of the water problem because water can often be reused if it is not contaminated. But, if human and industrial wastes are improperly handled, they can foul a mighty stream and prevent communities farther along its course from using its water without first giving it extensive chemical treatment. As the United States Public Health Service aptly puts it, "The river is a mainstay of modern civilization, and a pleasant companion to man, if undefiled, but an obstruction to economic and social progress, and a menace to life and health, if polluted."

Three-quarters of the earth's surface is covered with oceans. From this aqueous expanse, as well as from the rivers and lakes, the sun eternally draws vapor, which later condenses and falls from the clouds to either seep into the ground or run off to the sea. This never-ending cycle juggles the same water over and over. There is no more and no less moisture now than there was when Noah launched his ark, but the distribution changes markedly and sometimes abruptly. Witness that in the western part of the nation rainfall ranges from practically nil in portions of the Southwest to 100 inches a year in some sections of Washington. Industry and agriculture both follow water. That is why most of our factories and farms are in the Midwest and East. It could not be otherwise. The western third of the country could not support the concentrations of people that are found in some of the more populous areas farther east.

As the country continues to grow, the water problem will steadily become more acute and there will come a time when we shall have to turn to seawater to solve it. Several workable processes for desalting ocean water have been devised, but they are too expensive to handle large volumes. In June of this year a bill to appropriate $20 million for the development of more practical apparatus passed the House of Representatives. Further research will perhaps produce economical systems and one may well imagine that they will be in extensive use before many more decades have passed.

This and That

High Voltage Line

Eleven hundred men have worked seven years to complete a dam and hydroelectric station within the Arctic Circle in northern Sweden. Known as the Harspranget Project, it embodies an underground powerhouse and 600 miles of high-tension line to carry the current southward to the central part of the country. The main dam is 2520 feet long and 164 feet high and was built while the river was diverted through a tunnel 700 feet long and approximately 45 feet in diameter. A smaller dam was also erected to help create the reservoir.

The power-plant equipment consists of three 115,000-kw generators each driven by a Francis turbine. It occupies a 330-foot long room as high as a 5-story building and is carved out of solid rock. A tunnel 9500 feet long carries the water back to the river after it has passed the turbines. The transmission line operates at a potential of 380,000 volts, said to be the highest on record. It cost $20 million and the generating facilities $45 million.

★ ★ ★

To Ship Molten Sulphur

A barge designed to carry molten sulphur was recently launched at the Bethlehem Steel Company shipyard in Beaumont, Texas. It has a capacity of 1000 tons and is insulated with fiber glass that will keep the cargo at a temperature of near 300°F during its shipment from Texas Gulf Sulphur Company's mine near Liberty, Texas, to the plant of Consolidated Chemical Industries, Inc. in Houston. The sulphur is brought up from underground deposits in molten condition by sending down superheated steam. Transporting it in molten rather than in dry form makes remelting unnecessary when it is used by Consolidated in making sulphuric acid. Freeport Sulphur Company has for some time been shipping molten sulphur in barges from swampland producing areas to cooling and drying locations, but they have never previously been employed elsewhere. The new barge cost $160,000.

★ ★ ★

Giving Windows the Works

A blower driven by an airplane engine creates a blast of 140 miles per hour for testing shuttered windows in Florida. From behind the engine water is introduced at a rate of 20 gpm, the air and water being directed against a window for twelve minutes. Behind each one is a long metal funnel ending in a 6x6-inch opening, where a sensitive anemometer measures the amount of air that gets through. Water that passes between the slats is collected in a trough and measured. A jalousie is considered satisfactory for hurricane conditions if air and water infiltration do not exceed 75 cfm and 0.20 gpm respectively. The test has been adopted by the Florida Window Manufacturers Association, according to *Engineering News-Record*.

★ ★ ★

Probing Roman Church

Using methods akin to those of geophysical oil seekers, the Rev. Joseph Lynch, seismologist at Fordham University in New York City, has located hollow spaces underneath the marble floor of the basilica of St. Peter's in Rome's Vatican City. He thinks he may have found the site of Nero's Circus, where St. Peter was crucified, and the tomb of Palestrina, famous early Italian composer. In his investigations, which were conducted at the request of Vatican authorities, he detonated small charges of dynamite and measured the time it took pressure waves to travel through the ground to a seismograph. From the readings, he deduced that there is at least one room under the area examined. The cathedral is known to have been erected on the site of a pagan cemetery that dated back to Nero's day.

★ ★ ★

Manganese Reclaiming Process

Manganese, in which our nation is poor, is essential for steel making and every possibility of increasing our supply of it is being explored. The slag that is discarded from open-hearth furnaces contains appreciable quantities of the metal and is, consequently, under investigation by the Bureau of Mines. In the laboratory, slag containing eight to ten percent manganese has been upgraded in a blast furnace to an iron-manganese combination containing 20 percent of the latter metal and also considerable phosphorus. Next, by placing the material, which is known as spiegeleisen, in a basic-lined converter and blowing compressed air through it, the researchers produced a slag containing 50-55 percent manganese and only 0.1 percent phosphorus. It is now proposed to charge this product into a second blast furnace, with the expectation of obtaining a standard 80-percent ferromanganese.

The hope is that in addition to producing a valuable steelmaking material, the byproduct phosphorus-rich slag can be ground up and put to work as a commercial fertilizer. It is reported that there is a sufficient supply of this manganese-bearing open-hearth slag to yield up to 400,000 tons of 80-percent ferromanganese per year. That is about 50 percent of the nation's requirements.

★ ★ ★

Pluto's Steam Plant

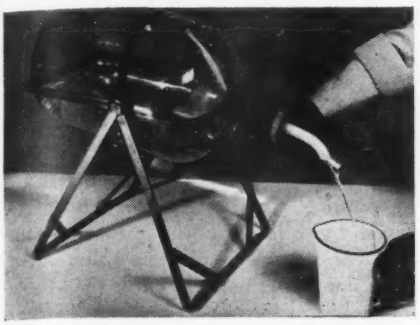
In Italy's Laradello Valley, some 40 miles south of Florence, circulating ground water comes in contact with hot volcanic lava and is vaporized. Bored holes tap the underground reservoirs, permitting the steam to be harnessed for driving turbine-generators. Exploitation of this resource began many years ago and by 1944 installed generating capacity was up to 800 million kw-hrs per year. However, the retreating Germans destroyed many of the facilities and complete reequipping was necessary. This has been done largely with Marshall Plan funds from the United States.

Steam now rises through 140 drilled holes and more outlets are being put down. Some penetrate 7000 feet, but most of them are between 1000 and 2000 feet deep. The Laradello generating stations have a combined capacity of nearly 2000 million kw-hrs annually and facilities for an additional 150,000 kw are planned. Two-thirds of the power is used by the Italian State Railways, a quarter by industries and the remainder by the Laradello Works themselves, which are mostly engaged in processing chemicals contained in water brought up with the steam. Laradello is strategically located between northern and southern Italy and transmission lines carry the power in both directions.

After passing through the turbines, the steam is condensed and the water used to irrigate agricultural land. The activities at Laradello give steady employment to 1500 persons and at times there are up to 400 temporary workers.

Industrial Notes

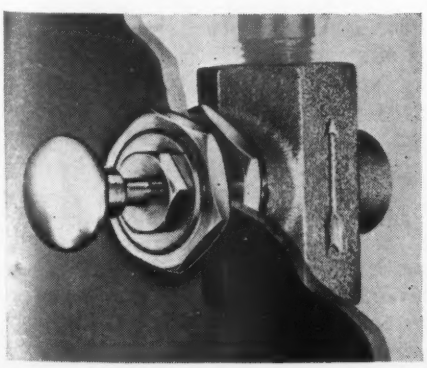
Dispensing liquids from large glass bottles into small containers is made safe and easy by use of the tilter and spout shown in the accompanying illustration. The supporting framework and cradle are of sturdy steel construction, and a metal chain holds the bottle in



position when it is tipped for pouring. The spout is of acid-resistant rubber and has plastic tubing. It fits any-size bottle and has an air vent to insure smooth flow. The unit is manufactured by the General Scientific Equipment Company and is said to prevent spilling and splashing that may cause injury when handling corrosive fluids.

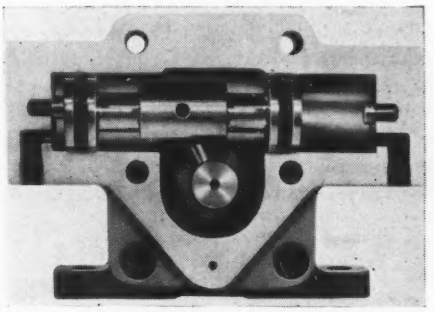
A lighter for service in automobiles uses vacuum from the manifold or windshield wiper to "draw" on a cigarette and get it going. We also read about a miniature compressor that pumps air into punctured tires while a car is in motion. It was shown at this year's model engineering exhibition in London, England. We don't know just how it's done without snarling up the delivery hose.

For use with air and gas lines where intermittent flow requires manual control there is available a self-closing push valve, a product recently introduced by King Engineering Corporation. The valve is opened by pressing a knob on the stem and closes automatically when pressure is released. It is sealed by readily accessible neoprene O-rings and, according to the manufacturer, has shown no leakage through the valve or around the stem during a breakdown test of one million operating cycles. Two styles



are available: Model PV, which is pictured, for mounting on panels up to 7/16 inch thick, and Model LV for in-the-line mounting. Inlets and outlets are tapped for ¼-inch pipe, and the rate of discharge is 25-30 cfm. Typical applications include hydrostatic gauges and other instruments that call for a manually controlled blast of air, single and multiple pressure test stands, blowing out or purging gas or air lines, and processing operations that need an occasional shot of gas or air.

POV stands for power-operated valve, a recent product announced by Ledeen Manufacturing Company for the control of air, oil and water in services where hand- or foot-operated valves cannot be used. Essentially a standard 4-way unit, the disk is rotated by a piston moved by the pressure of the main-line operating fluid and controlled by small pilot valves. Pressure applied through the pilot on one end of the piston forces it ahead and turns the disk to the forward position; pressure exerted on the opposite end causes the piston to move back and rotate the disk to the reverse position. The power valves are available in six sizes with the choice of finger, toe, cam or solenoid-pilot control. They are designed for varied purposes such as automatic operation, where the movement of some part of a mech-



anism must start the valve to initiate another movement; remote control; reciprocating service, where the cylinder must travel back and forth continuously; and safety, where electric-power or line-pressure failure must reverse the valve.

The U. S. Bureau of Reclamation used compressed air to test the joints of 42-inch reinforced-concrete pipe laid on the Central Valley Project in California, but it got the air the hard way — with a bicycle pump. Connectors consist of rings with gaskets, one on each side.

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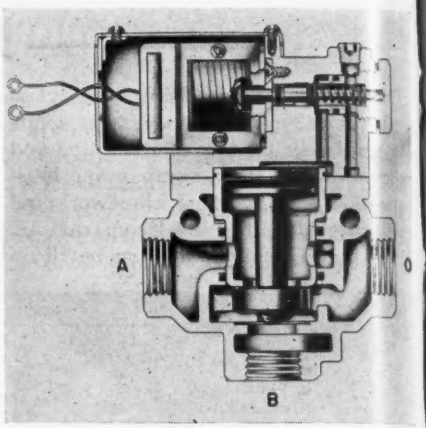
For testing, a man entered the pipe, put some water in the space between the gaskets and then applied air until it reached the pressure for which the line was designed. Any leakage appeared on the outside of the pipe and could be corrected before the pit was covered.

Adaptability, simplicity and ease of maintenance are characteristics claimed by Hannifin Corporation for its new Pilot-Master valve for the directional control of air pressure. The main valve section can be operated either 2- or 3-way normally open or normally closed to pressure without any internal change because the inlet and exhaust ports are interchangeable. In the accompanying cross-sectional view, Port A is the inlet for normally closed operation and the exhaust for normally open use; Port B is the inlet for normally open and the exhaust for normally closed service. Insertion of a pipe plug in the "exhaust" of either A or B converts the valve for 2-way use. In any case, Port O is the outlet to an air cylinder. The main valve is pressure operated through a piston-type poppet which fits in a removable cartridge that acts both as the cylinder for the piston and as the upper seat for the poppet. The cartridge can be replaced by removing the pilot head in which is a 3-way solenoid pilot valve which controls the main valve by admitting pressure into or exhausting it from the chamber above the piston. The pilot valve is also a poppet in that its stem is actuated by the plunger of the solenoid and returned by a lightly stressed spring. The Pilot-Master valve will shift in less than 1/20 of a second, it is claimed, on 60-cycle current. It can be supplied with a d-c solenoid. The valve is available in five sizes from ⅜ inch through 1¼ inches (inside pipe diameter).



After two years of testing, Galvanite Corporation has placed on the market a compound for the protection of steel and iron surfaces that is said to be equal and in many cases superior to conventional galvanizing processes such as electroplating, hot dipping, cementing and painting. Called Galvanite and applied cold, it leaves a coating, says the manufacturer, that is 96 parts, by weight, chemically pure zinc. This combines with the base metal and not only prevents corrosion, electrolysis and marine

"Yeah, I wrote it down. No, I won't lose it. Yeah, O.K., I have it."

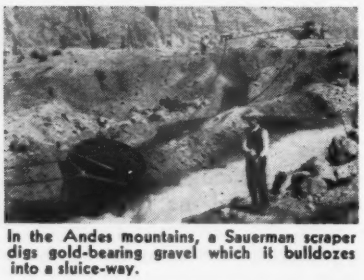
MOVE MORE YARDAGE... at less COST!

Hill of volcanic ash 250 ft. high is moved by 3 cu. yd. Sauerman Scraper which loads the material into cars using a simple ramp.

Big Excavations Handled in One Operation by a

SAUERMAN SCRAPER

In far northern Alberta, Canada, valuable tar sands are dug from a river bluff by a 1 cu. yd. Sauerman scraper.



In the Andes mountains, a Sauerman scraper digs gold-bearing gravel which it bulldozes into a sluice-way.

Many difficult dig-and-haul jobs, such as the three illustrated here, are reduced to simple terms and big savings effected by use of a Sauerman Drag Scraper Machine.

An exclusive feature of the Sauerman Machine is the unique Crescent bottomless scraper bucket. Because of its streamline design, the "Crescent" penetrates hard materials with the ease of a plowshare, gathers a full load in a few seconds, then rides its load to the dumping point where it makes an instantaneous, clean dump. Twenty to forty or more heaping loads moved per hour, the exact number of round trips of the scraper bucket depending upon the length of the operating span.

The operator, sitting in a comfortable control station, easily guides the scraper over a large area. Automatic shifting of the tail end of the machine is provided where desired. Power requirement is moderate. Installation and upkeep costs are low. Sizes from ⅓ cu. yd. to 15 cu. yd. cover the needs of all material handling jobs—large or small.

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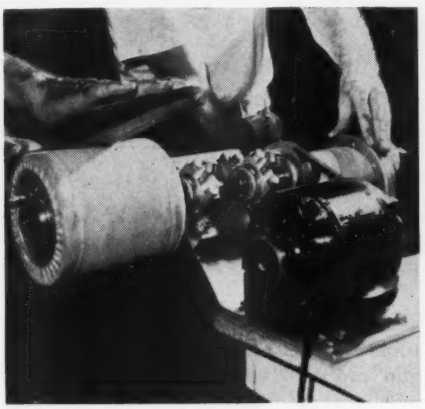
548 S. Clinton St. Chicago 7, Ill.

growths but also checks rusting when spread on corroded surfaces. Within 48 minutes after application the compound is dry and the material ready for use.

Production is soon to start in a Rutlant, Vt., plant on a new insulating material developed by the Samica Corporation for the electrical industry. It is made of mine waste and scrap mica and will be turned out in continuous sheets on a special papermaking machine.

Inflatable cylindrical sleeves for sanding machines facilitate rounding sharp edges by permitting the work to be pressed into the yielding surface and enable the machines to perform some operations on irregular shapes that have previously called for hand sanding. The pneumatic sleeves are made by Hickory Hill Manufacturing Company in five diameters ranging from 2 to 6 inches, all 7



inches long. Each is equipped with an ordinary tire-type valve for inflation with a hand-operated pump. The sleeves fit on drums that are revolved by any available means.

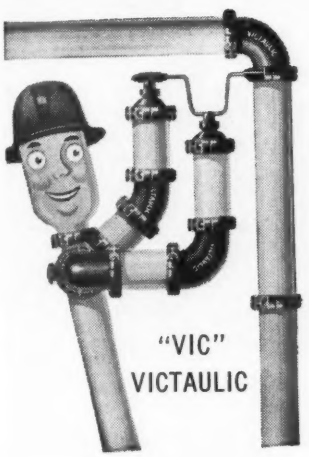
The appliances are suitable for working on wood, plastic, or metal, all of which can be ground, buffed, or polished by choosing the proper grit. The degree of inflation is varied in accordance with the material handled. Recommended speeds are 1200 rpm for wood and plastic and up to 1400 for metals.

Six years ago the nonprofit organization CARE was formed in New York to handle the shipment and delivery of gift packages to needy people overseas. It began with food, then broadened the list to include textiles, books, and tools. The latest tool kit, priced at $20, is for young carpenters' and joiners' apprentices in western Germany whose parents haven't the funds to get them started in their chosen trade.

Motor cars of the future may have built-in windshield de-icers. It is reported that scientists of Britain's National Physical Laboratory have developed a process by which a transparent film of gold can be sandwiched between

THE VICTAULIC® METHOD OF PIPING

EASIEST WAY TO MAKE ENDS MEET



The VICTAULIC METHOD is a *complete* line of Victaulic Couplings, Full-Flow Fittings and Vic-Groover Tools for mechanical piping construction. It's the easy way to hook-up pipe . . . it's fast and versatile . . . it's *complete and all-inclusive!* Use the VICTAULIC METHOD and you streamline piping . . . cut costs!

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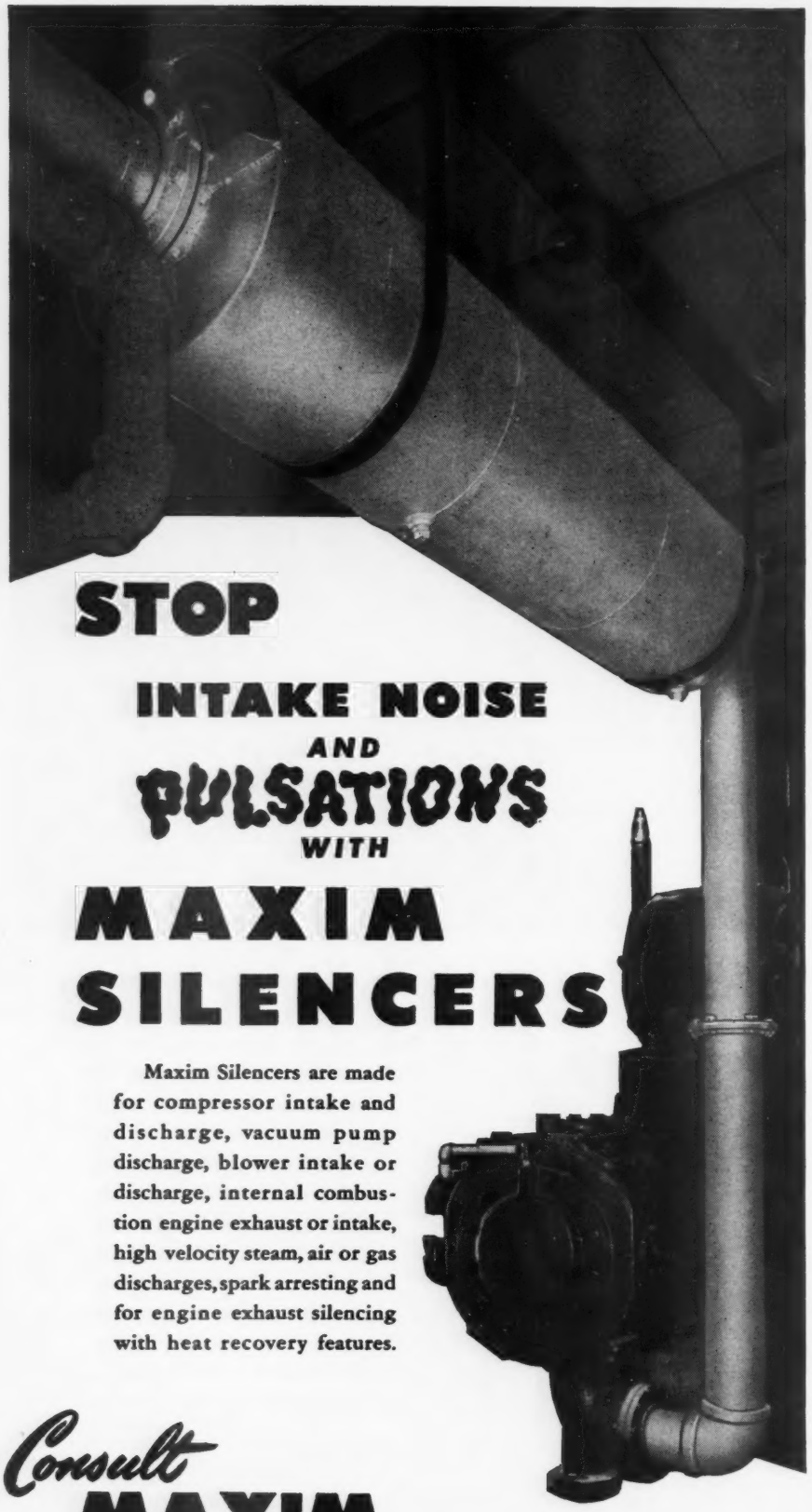

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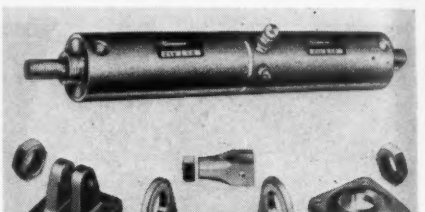
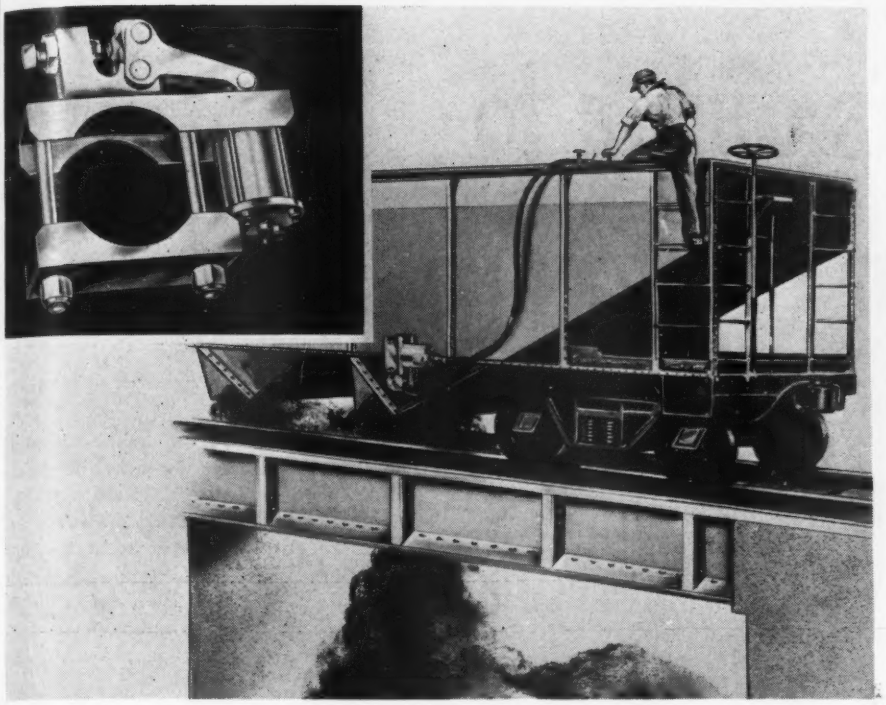
layers of glass to insure unobstructed vision in cold weather. The yellow metal, an excellent conductor of electricity, will keep the windshield warm and thus melt snow and ice. Something similar was tried earlier with metal oxides but with less success. Questioned as to cost, the scientists said the film of gold is not expensive because it is only one-quarter of one-millionth inch thick.

Modernair Corporation has announced the addition of a new air-hydraulic cylinder to its line of industrial pressure-operated devices. It is designed to use standard shop air-line pressure and has a built-in hydraulic system with an adjustable speed control. It is at present available in two bore sizes, 2 and 3 inches (others made to order), featuring interchangeable mounting brackets and a flush exterior that permit installation in any position and in restricted spaces.



The cylinders are suitable for powering tools or work in process of machining and are said to insure rapid traverse, nicely controlled movement and fast reverse action.

To short-circuit the electrolytic action that attacks 410 and 416 chrome-steel valve stems after hydrostatic tests, Crane Packing Company has developed a new packing, designated as Style 187. The latter embodies a special sacrificial metal that is said to sidetrack electrolysis and the pitting action that would otherwise occur during the period between testing and actual valve use. The packing is braided of pure asbestos yarn around a resilient graphite and asbestos core and is impregnated throughout with an antifrictional dry-graphite lubricant. It is designed for use with steam valves



For vibrators required temporarily to facilitate the transfer of certain bulk materials from carriers, Viber Company has developed an air-operated clamp that makes it possible to attach and detach the units and to shift them from one car or truck to another in a matter of seconds, it is claimed. It consists of two metal jaws that securely grip any suitable steel angle or other member when air is admitted to a small pneumatic cylinder, which is an integral part of the clamp, as the insert in the accompanying picture shows. A single line with a "Y" connection feeds the air to the cylinder and to the vibrator. Pressure on the jaws is maintained by air power for short unloading periods, but when a vibrator is to function for a considerable length of time, the clamp can be secured by bolts and the use of air eliminated. Pneumatic vibrators for which the clamp was designed have found wide application in foundries and in the ceramic, cement, coal and food-processing and other industries.

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at temperatures up to 850°F and pressures to 2000 psi. It can be die-formed into any desired shape and size.

Labelon is a recently developed pressure-sensitive plastic tape you can write on with pencil, dry ballpoint pen or stylus. It may be applied to bottles, salesmen's samples and tool bins—to anything, in fact, that offers a smooth surface—and is said to be resistant to smudging, dirt, oil, water and acids; unaffected by temperatures from minus 40 to plus 160°F; and to peel off easily when no longer required. The tape is made in many different colors, widths and roll lengths with suitable dispensers by Labelon Tape Company, Inc., 450 Atlantic Avenue, Rochester 9, N. Y.

"He's a good man, but when he's got a hangover he just can't follow a straight line."

Insulating paper made of quartz has been produced in the U.S. Naval Research Laboratory and may be used for some purposes as a substitute for asbestos insulation. It resists temperatures up to 3000°F and is free of boron, properties that make it suitable for insulating electric cables and for service in atomic-energy power plants. Full information about the material is contained in Release 344-52 obtainable from the Department of Defense, Office of Public Information, Washington 25, D. C.

Sashlights of Resolite—a translucent, shatterproof material made of polyester resins and Fiberglas—are recommended for industrial plants, especially where breakage of glass panes through vibra-

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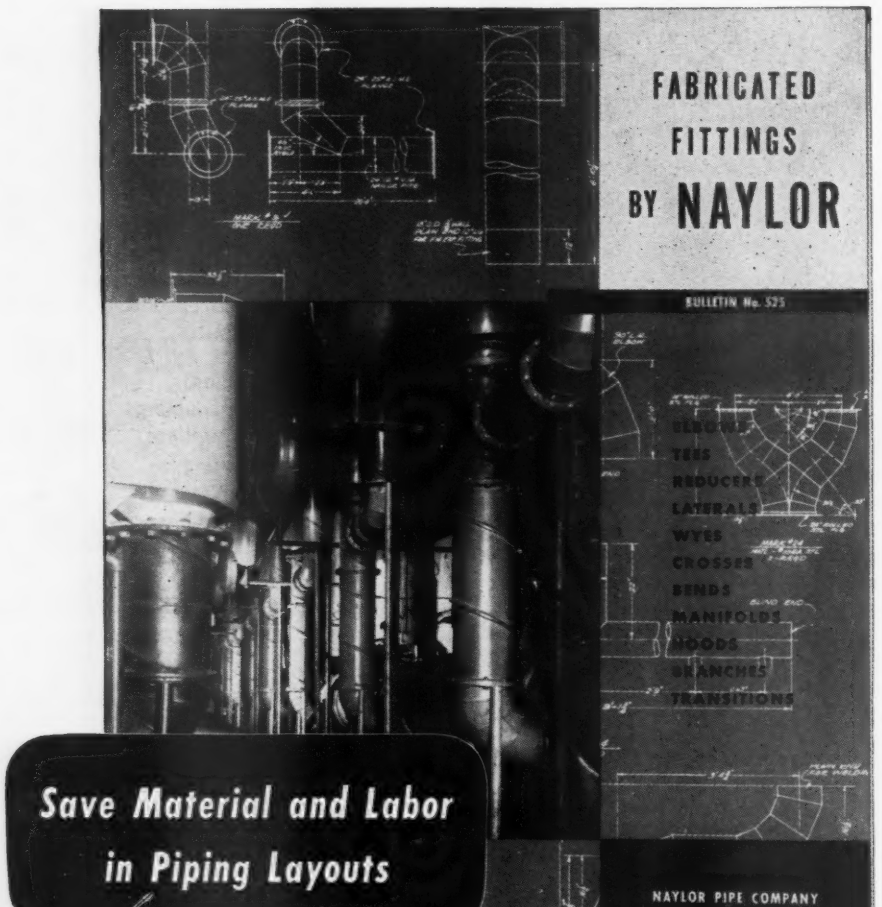


Write for this helpful bulletin on Naylor Fabrication Service. It presents data on standard and special fittings for lightweight pipe and offers practical ideas to simplify piping layouts. Included are special fabrications to save time, material and labor through eliminating numerous flanged joints and combining many fittings into one integral unit. Ask for Bulletin No. 525.

NAYLOR PIPE

Naylor Pipe Company
1245 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

tion or other causes is a factor. It is manufactured by Resolite Corporation in flat sheets up to 42x96 inches in size in eight standard colors, including light green which is best suited for windows. It is claimed that the material is not affected by moisture and that it withstands extreme heat and cold and the normal run of acids and alkalies.

QUOTES

—FROM HERE AND THERE

Drive-in Bank

"Pneumatic tubes make banking quicker and easier for customers who don't want to leave their autos. At a Bridgeport, Conn., bank the tubes link drive-in tellers' windows with the main checking, savings and bookkeeping departments; compressed air speeds deposits and withdrawals to and from the cars."

Wall Street Journal, June 5, 1952

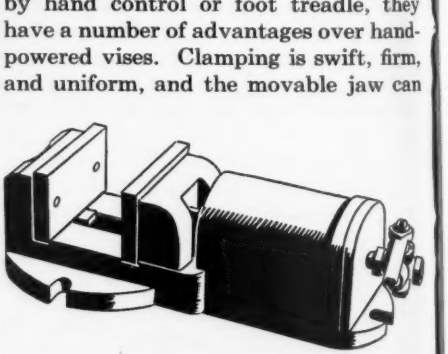
Air-jetting Poles

"Several line construction contractors have set wood power-line poles in wet and sandy locations with the aid of air jets. They report that there must be sufficient water in the hole for the air to stir up and puddle the soil. If the pole is rocked back and forth, it will sink gradually to the desired depth. This air-jet method cannot be used where extra hard soil or hardpan is encountered."

W. L. Pilsbury, Florida Power Corporation, St. Petersburg, in Electrical World of June 30, 1952

Pneumatic Vises

"Air-operated vises are used quite widely, since most shops are equipped with the necessary air compressors and piping to service them. Actuated either by hand control or foot treadle, they have a number of advantages over hand-powered vises. Clamping is swift, firm, and uniform, and the movable jaw can



shift to gripping position in one motion. Vises develop clamping pressure of several tons from a line pressure of only 100 pounds. Jaw area is kept to a minimum, exposing a greater work surface to the action of processing tools. From a maintenance standpoint, air-operated vises are easy to take care of, since elimination of excessive clamping pressures means less wear on working parts."

From an article, Use and Care of Vises, Mill & Factory, June, 1952

Industrial Literature

Barksdale Valves, 1566 E. Slauson Avenue, Los Angeles 11, Calif., describes its complete new line of Shear-Seal solenoid valves in Catalogue 1B-2 now available upon request. The series consists of shut-off 2-way diverter and 3- and 4-way selector valves for air, water or oil service and comes in three pressure-range groups from 0 to 3000.

Federal Machinery Company, 134 Grand Street, New York 13, N. Y., offers sheet-metal fabricating shops a 32-page catalogue of its standard punches and dies of various types for hand, foot, and power presses. Punch and die adaptors and die shoes also are described and illustrated. The booklet was compiled principally as a guide to facilitate ordering. For a copy address the company's Sales Department.

Gear shapers are the subject of an 8-page illustrated bulletin obtainable from Michigan Tool Company, 7171 E. McNichols Road, Detroit 12, Mich. Latest applications of the company's improved line of Series 1800 Shear-Speed radial shapers and of a new model are covered, as well as specifications, design changes and typical shapes that can be produced by them. Ask for Bulletin No. 1800-52.

The 1952 edition of *Wheelco Data Book and Catalog*, a 52-page publication, is now available upon request. It contains prices, application recommendations and pertinent information about instrument sensing units and accessories made by Wheelco Instruments Division, Barber-Colman Company, Rockford, Ill. Designated as Bulletin TC 9, it is a valuable asset in applying indicating, controlling and recording instruments.

Minneapolis-Honeywell Regulator Company is distributing a catalogue describing its recording or indicating circular-case electric-control thermometers for regulating the temperature of drying ovens, lumber kilns, plating tanks and cooking vessels. Other pertinent information also is included. Write to the company at Station 40, Wayne and Windrim Avenues, Philadelphia 44, Pa., for Catalogue 6482.

In a 4-page brochure (52-401) The Do-ALL Company, Des Plaines, Ill., describes its new indexing attachment for surface grinders that permits grinding cylindrical and angular forms. The attachment features a built-in 2-way sine-bar tilt arrangement that simplifies setting taper angles with gauge blocks which eliminate guesswork. Illustrations show the many setups possible with the attachment.

The Garlock Packing Company, Palmyra, N. Y., is distributing an 8-page bulletin outlining the advantages of its Lattice-Braid rod packing. In addition to sectional drawings showing the unique structure of the packing, the publication contains specifications and broadly indicates the types to be selected for varied services. Copies of *Garlock Lattice-Braid* are available by writing to the company.

Those with gauging problems may be interested in a 38-page illustrated booklet, titled *Dimensional Control and Gaging Policy*, published by The Sheffield Corporation, Dayton 1, Ohio. It covers such subjects as tolerances, reference temperatures, ordnance practices, instruments, fixed gauges and multiple semiautomatic and automatic gauging devices. Anyone interested can obtain a single copy without charge by writing to the Company.

A new piece of informative literature is offered by Allis-Chalmers Manufacturing Company, 1000 S. 70th Street, Milwaukee, Wis., on the new Magic Grip bushing for its stationary-control, wide-range Vari-Pitch sheaves. The new bushing is said to make for quick and easy installation and removal of sheaves from shafts and, as compared with the old style, has reduced the weight of the sheave-and-bushing assembly about 20 percent.

"The knot is to remind me to bring up the diver in an hour."

Donaldson Field Engineers *Cover the Continent*

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These men are on *our* payroll, but they work for *you*. Their job is to make sure that *your* equipment stays properly protected against dust, or that Donaldson Mufflers continue to do their job. Highly unusual conditions of climate, dust or geography that create problems requiring on-the-spot study, take them to every corner of the continent.

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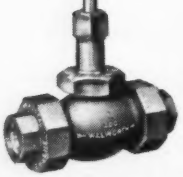
Pressure-Seal Cast Steel Gate Valve

Small Cast Steel Angle and Y-Globe Valves for high-pressure service

Walseal Bronze Strainer



Walseal Bronze Globe Valve

Walseal Bronze Elbow

Walseal Bronze Union End Tee

Walworth is proud to be aboard the S. S. United States

When the United States Lines, the Newport News Shipbuilding & Dry Dock Company, and Gibbs & Cox, Inc., naval architects, join forces to build the fastest, safest and most modern liner the world has ever seen, the selected materials and components have to be top quality. Walworth Pressure-Seal Cast Steel Gate, Globe, and Angle Valves, and Walworth Small Cast Steel Angle and Y-Globe Valves for high-pressure service are installed in the main steam lines of the S. S. United States. Brass and copper lines use large numbers of Walseal valves, fittings, strainers, and unions.

Knowing that Walworth valves and fittings are a vital part of the power arteries aboard this great ship, the proudest moment of Walworth's 110 years of manufacturing experience came when the new Queen of the Sea broke both the east and west trans-Atlantic speed records.

As we present our compliments to Commodore Manning and his crew, to the Newport News Shipbuilding & Dry Dock Company and its men, and to William F. Gibbs and his staff, we also compliment the men and women of the Walworth Company who gave of themselves to put quality into our products and this quality ship.

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